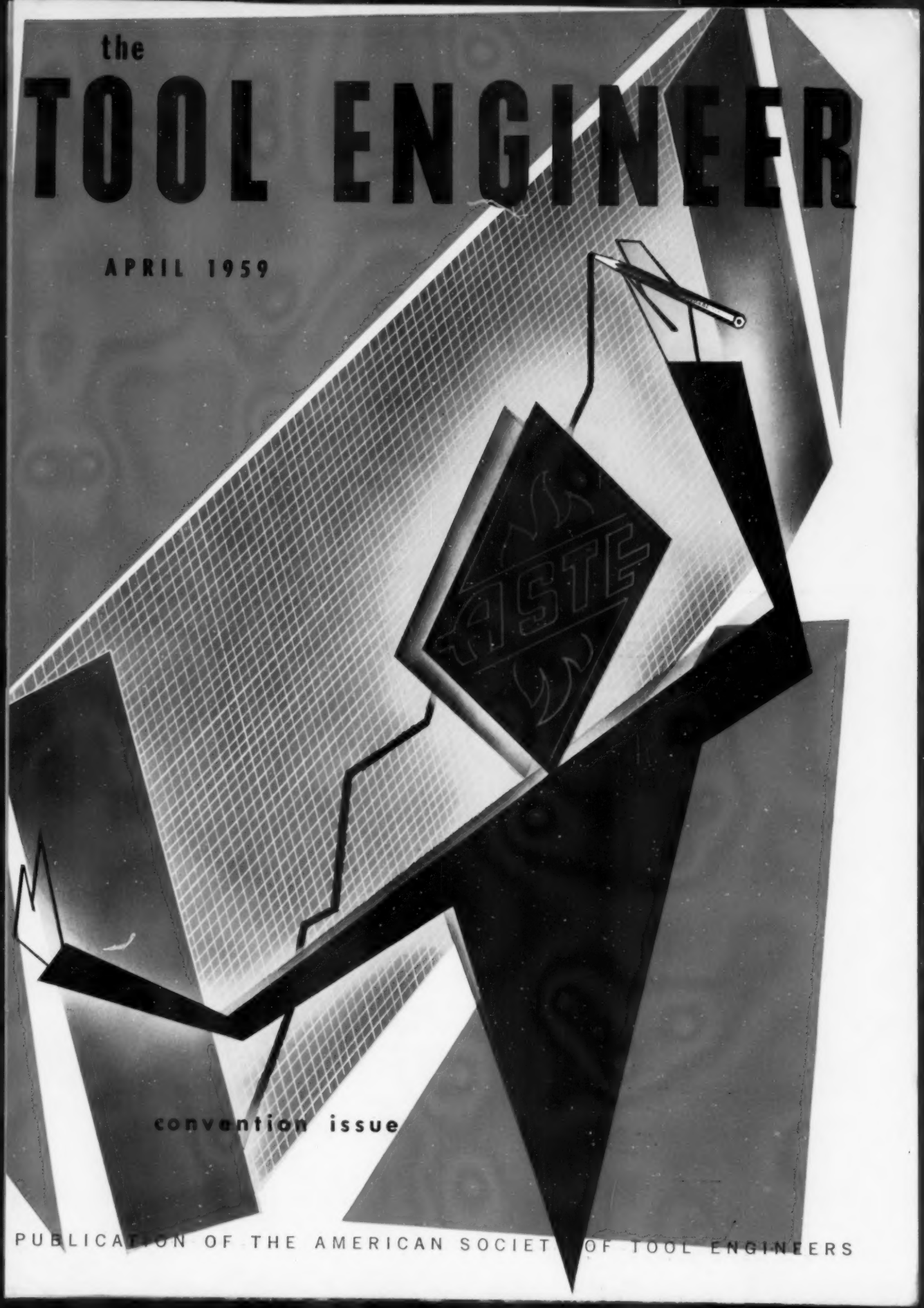
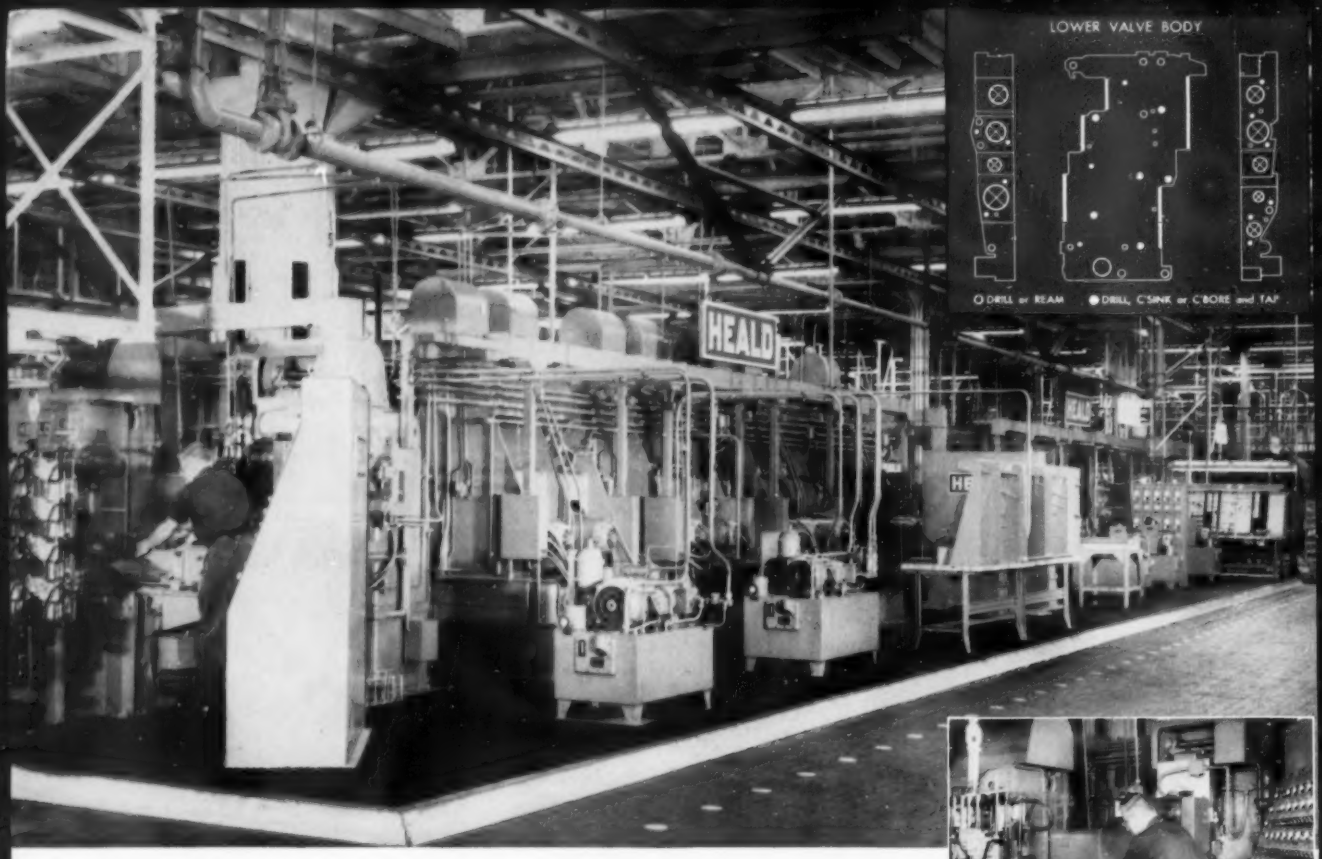
the TOOL ENGINEER

APRIL 1959



convention issue

PUBLICATION OF THE AMERICAN SOCIETY OF TOOL ENGINEERS



HEALD AUTOMATED LINE performs

171 OPERATIONS

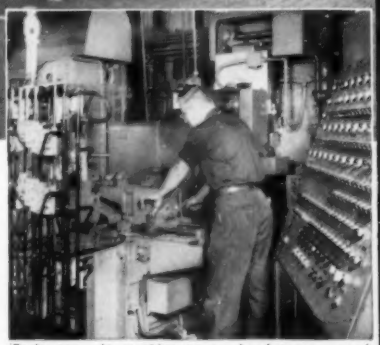
Two identical 39-station Bore-Matic transfer lines drill, bore, ream, tap, face, probe and gage 48 bores and 5 side faces of transmission valve bodies

REPRESENTING the ultimate in straight-line automation, these Heald Model S Bore-Matic transfer lines are speeding the precision production of valve bodies at one of America's leading automotive plants.

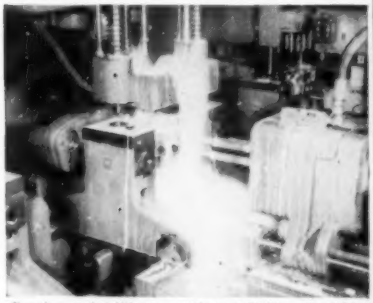
Each line consists of two 50-foot sections — a 19-station section for the small-bore and semi-finish facing operations and a 20-station section for core drilling, reaming and finish facing. A total of 171 operations (112 machining, 52 probing and 7 air gaging) are performed in a fully automatic palletized transfer line with a cycle time of 18 seconds for each station.

Compared to previous methods, the new Heald system results in less handling and locating of parts, fewer rejects, greater efficiency and substantially lower production costs.

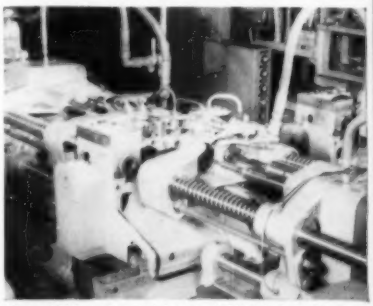
For complete information on this interesting installation, send for a copy of the February 1959 issue of The Heald Herald.



Parts come to machine on overhead conveyor and are semi-automatically loaded onto the transfer pallets. Push button control console for all stations is shown at right.



Tapping and drilling operation at Station 12 of Section 1. Probing station is shown in the background.



Core drilling of spool bores at Station 4 of Section 2. Bores are then semi-finish and finish reamed and air gaged for diameter.

HEALD

IT PAYS TO COME TO HEALD!

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.

Worcester 6, Massachusetts

Chicago • Cleveland • Dayton • Detroit • Indianapolis • New York

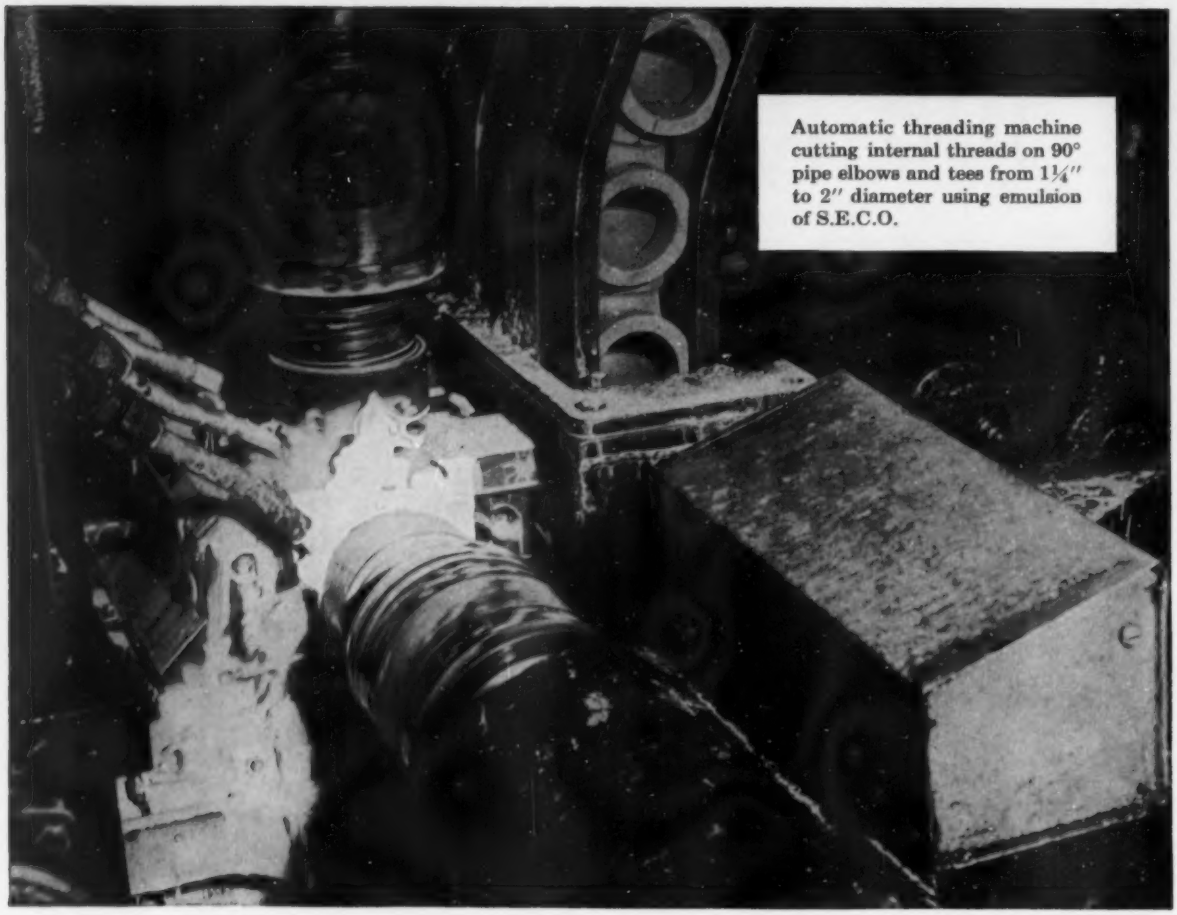
the tool engineer

Vol. 42, No. 4 April 1959

THIS MONTH'S COVER

One of the highlights of this year's ASTE Annual Meeting will be the "Planning for Profit" Seminar. The Seminar theme is carried out in this cover by William Solms. It is also illustrated in the lead article starting on page 79, which shows how successful companies plan for profitable and efficient operations.

THE TOOL ENGINEER is regularly indexed in the *Engineering Index Service* and *Applied Science & Technology Index*.



Automatic threading machine cutting internal threads on 90° pipe elbows and tees from 1¼" to 2" diameter using emulsion of S.E.C.O.

Photo courtesy of Grinnell Corporation

NEW S.E.C.O. EMULSIONS, WITH SMALLER OIL-PARTICLE SIZE, CUT PRODUCTION COSTS

There's a new and greatly improved S.E.C.O. (Sunoco® Emulsifying Cutting Oil), that has smaller emulsion-particle size to give you the following benefits:

- BETTER PROTECTION AGAINST RUST, even at emulsion ratios as lean as 40-to-1.
- BETTER DETERGENCY, which permits dirt and fines to settle quickly out of emulsions, leaving machines clean.
- BETTER EMULSION STABILITY. Even in hard-water areas, emulsions of *new* S.E.C.O. stand up better than those made with other regular emulsifying cutting oils.
- BETTER FINISHES, CLOSER TOLERANCES. New S.E.C.O., with better coverage and wetting of work, produces consistently finer finishes in machining. Reject rate falls off. Tool life increases.

TRY *NEW* S.E.C.O.—for increased economy in all machining operations. Ask your Sun representative, or write to Department TE-4.

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Time for Planning

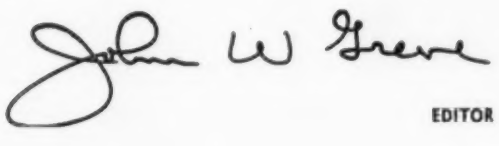
When you have designed computers to save engineering time and to eliminate the drudgery from design work, what will you do with the time you have saved? That was a question posed at the recent dedication of General Electric's new computer plant at Phoenix, Arizona. Mr. Kenneth R. Geiser, Manager of Engineering, replied "We will use the free time to design more computers."

He could have added also that more computers would be available for programming more production operations in the shop. This, in turn, would free more workers for more highly rated work like planning programs and maintaining highly complicated production equipment. The net result would be snowballing operations that would produce more equipment for making more products. The worker, the public and the nation would profit by having more good things of life at competitive prices.

At Phoenix, such programming operations are already being used and others of a revolutionary nature are being developed. For instance, the many holes of various sizes are drilled into printed-wire circuit cards by tape-controlled machines. Also, wire terminals are connected by cold welding with a wire-wrap tool.

This latter operation is now being refined in such a way that all circuits will be pretested before connection. If an operator should attempt to make a connection to a wrong terminal or out of sequence in the wiring diagram, the wire-wrap gun would be inoperative. It would remain inoperative until the operator made the proper connection. In this way, errors are practically detected before they occur. In effect, much time is saved because no rewiring of a panel becomes necessary as a result of faulty wiring procedures.

Improved methods such as these justify planning and dreaming. When dreams become realities, creative time becomes available for more constructive planning.



EDITOR

versatility:
precision grind TWO parallel surfaces of widely varying parts in ONE operation

Gardner 2H30
precision double spindle grinder

Send prints of your parts for a Gardner proposal and request new general catalog.

GARDNER
precision disc grinders
BELOIT, WISCONSIN

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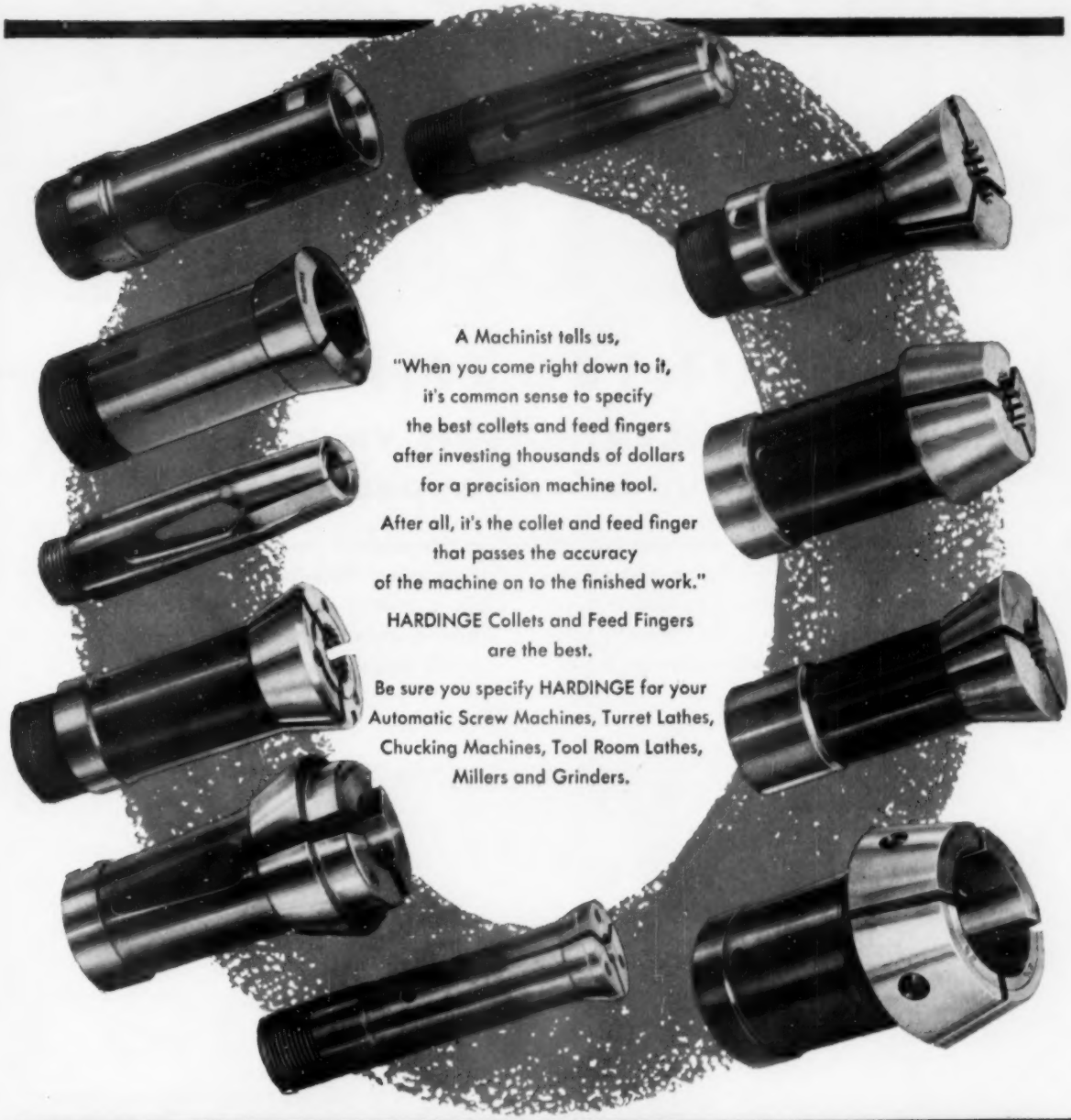
Collets and Feed Fingers

and *Get the MOST from your Investment in Machine Tools*



A Machinist tells us,
"When you come right down to it,
it's common sense to specify
the best collets and feed fingers
after investing thousands of dollars
for a precision machine tool.

After all, it's the collet and feed finger
that passes the accuracy
of the machine on to the finished work."

HARDINGE Collets and Feed Fingers
are the best.

Be sure you specify HARDINGE for your
Automatic Screw Machines, Turret Lathes,
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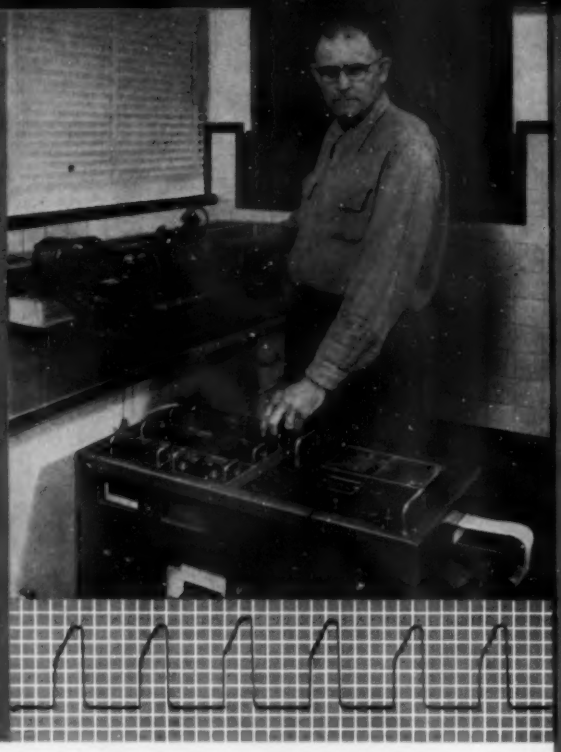
Immediate stock delivery from Elmira, Boston, Atlanta, New York, Hartford, Philadelphia, Rochester, Dayton, Detroit, Minneapolis, Chicago, St. Louis, Oakland, Los Angeles, Toronto, Montreal.



UNIFORMITY

With BALANCED ACTION you're *sure* of accurate, unvaried tapped holes . . .

The "lead checking" machine pictured here was developed in our research department to insure uniform lead in every tap. Equipped with an electronically actuated probe and sensitive strain-gage pick-up, this machine produces a tape picture which shows deviation of lead to .0001". This is another reason Winter taps last longer and consistently provide more accurately tapped holes.

WINTER

Call your distributor for standard and special Winter Brothers Balanced Action Taps, Dies and Gages.

WINTER BROTHERS COMPANY
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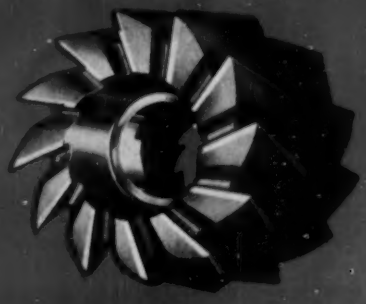
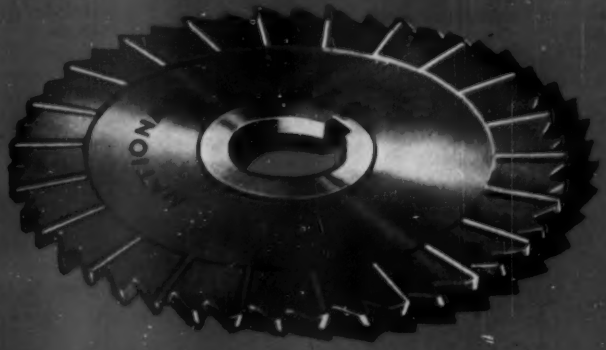




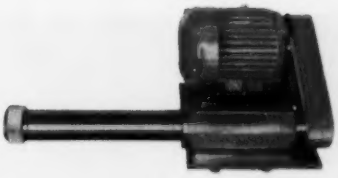
FOR BIG, HEAVY DUTY PRECISION SPINDLES

that produce BIG savings in production cost

SPECIFY POPE

POPE P-18670 Heavy Duty, High Speed Milling Spindle, 4 ft. long, 10 in. dia.; weight about 1000 lbs.

POPE P-18842 Deep Hole Internal Grinding Spindle, 10 HP, 7 ft. long, 12 in. dia. barrel; weight 4000 lbs.



POPE P-5794B Motorized Deep Hole Grinding Spindle, 10 HP, 36 in. long, 6 in. dia. barrel, for use in horizontal or vertical position on boring mills or planers; weight about 800 lbs.

POPE P-18844 Vertical Bearing Grinder Spindle, 20 HP, 6 ft. long, 12 in. dia. barrel; weight approx. 4000 lbs.

POPE P-1098 Heavy Duty Internal and External Grinding Spindle, 50 HP, for wheel of 30 in. dia. and 12 in. width; weight approx. 6000 lbs.

POPE P-10009E Motorized Deep Hole Grinding Spindle, 5 HP, 36 in. long, 5 in. dia. barrel; weight 600 lbs.

POPE P-1076 Cylindrical Grinding Spindle, designed for crush dressing and form grinding; 5 ft. long, 10 in. dia. barrel, for 24 in. dia.; 4 in. wide wheel; weight about 1250 lbs.

POPE P-A1 Deep Hole, Ram Type Grinding Spindle attached to boring machine, 10 HP, 10 ft. long, 10 in. dia. barrel; weight 2000 lbs. (For purposes of comparison, a Pope P-32 6″ x 18″ Surface Grinder Spindle is shown in the foreground.)

Send us your specifications and get prompt quotations on the one best Spindle for your work, out of the 20,000 different Precision Spindles that bear the name "POPE".

No. 125

POPE®

ENGINEERS AND BUILDS STANDARD AND SPECIAL PRECISION ANTI-FRICTION BEARING SPINDLES FOR EVERY PURPOSE

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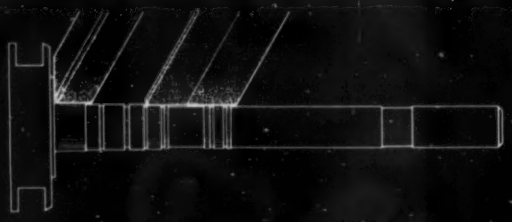
Established 1920

new
Landis R plunge
automatic production grinder



New Landis R Plunge Grinder automatically grinding 3 diameters and face of 100 transmission shafts per hour with dependable accuracy.

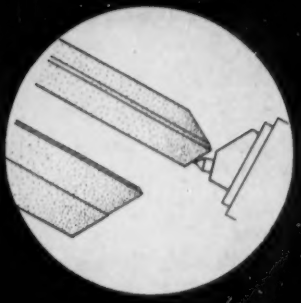
grinder

for consistent "tenths" tolerances

...completely new concept in production grinder design now gives you these new features for lower production costs

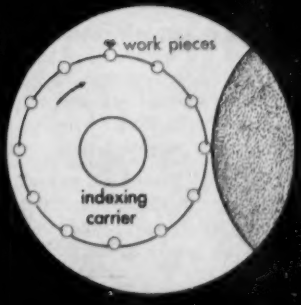
Landis MICROFEED—a new feed, symbolized by this mark, that guarantees "tenths" tolerances on a production basis

- automatically compensates for wheel wear and machine temperature variations
- eliminates costly rejects and reworking
- easy-to-set feed reduces set-up time



TRUFORM—a new dresser for accurate duplication of the profile to the wheel

- mounted on pre-loaded steel balls, to keep friction to a minimum for easy movement and accurate dressing
- dresses profiled wheels with angles up to 60°
- pushbutton control assures uniform dressing cycles



NEW Landis design assures stability and convenient maintenance

- new design box bed allows use of high production indexing rotary loader
- coolant, oil and valves outside bed
- automatic lubrication
- meets J.I.C. electrical and hydraulic standards
- automatic lateral location of work

LANDIS

precision grinders

LANDIS TOOL COMPANY WAYNESBORO, PENNSYLVANIA

GISHOLT NUMBER 12 AUTOMATIC CHUCKING LATHE

Unequaled in its size range, in versatility, speed and low-cost production

Whether it's for continuous operation in mass production or a wide variety of parts in small lots, this machine is in a class by itself.

Faster automatic cycle. The No. 12 is a fully automatic chucking lathe, capable of performing all types of machining operations in rapid sequence. With 420 spindle speeds ranging from 40 to 2600 r.p.m. and an infinite selection of feeds, it meets every requirement for stock removal, finish and minimum f.t.f. time.

Complete range of accessories. Front, rear, auxiliary and overhead slides can be applied; angular cuts are easily made; JETracer of single- or multiple-pass types can be used. Automation can be incorporated—from simple loading and unloading to gaging and sorting of finished pieces.

Greater power and rigidity. Here, too, is the power (up to 40 h.p.) with rigidity to take full advantage of the newest tooling and the heaviest cuts without vibration.

Boosts operator productivity. It requires a minimum of operator skill and attention—allows him to handle additional machines.

With all its speed and ruggedness, the No. 12 has the extreme flexibility of motions to handle practically any machining job on parts up to 16½" in diameter. It delivers high production with consistent accuracy and less dependence than ever on operator skill.

Ask your Gisholt Representative or write for Bulletin 1213, just off the press.

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Investigate Gisholt's Extended Payment and Leasing Plans

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5,790 IN-STOCK Drill Types and Sizes

GIVE YOU UNEQUALLED DESIGN AND SIZE SELECTION

For Any Material . . . Any Application

Continuous Production . . .

Is assured when you specify **W & B** because Whitman & Barnes carries more inventories to meet your production needs.

Application Tested . . .

For proved quality performance! You get longer tool life . . . less down-time . . . lower costs!

Fast Service . . .

Is yours from a **W & B** distributor. He maintains complete stocks to give you drop-of-the-hat deliveries.

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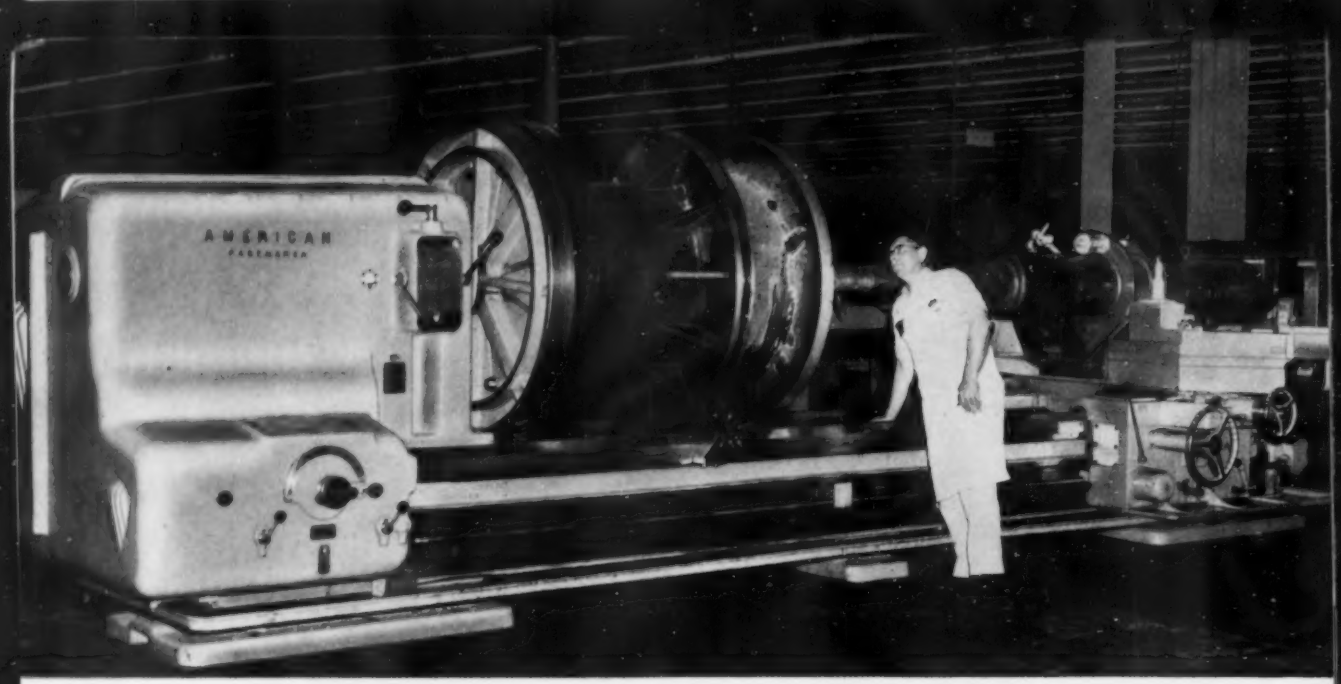
DRILLS AND REAMERS

40120 PLYMOUTH ROAD • PLYMOUTH, MICHIGAN

NEW YORK CHICAGO LOS ANGELES

The two drills shown illustrate the range of standard drill sizes and types available from W & B inventories.



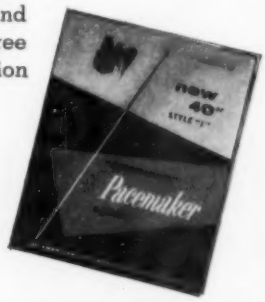
HERE'S THE *VISUAL* ANSWER!

Any question about the capacity of "AMERICAN" Lathe Spindle bearings or the stiffness of "AMERICAN" Spindles is certainly answered by this illustration.

Here is a 40" "J-9" "AMERICAN" Deluxe Model Hydraulic Duplicating Lathe (one of three, 40" "J" "AMERICANS") in the Charlotte, North Carolina plant of the Douglas Aircraft Company, Inc., boring a 54" diameter bulge die weighing five (5) tons. This illustration shows an ingenious roller rest made by Douglas but on many operations no steady rest is used.

This is a 60 horse power lathe with spindle and spindle bearings of tremendous capacities, consequently is ideally adapted to "elephant" operations of this nature and there are other exclusive design features contributing to the excellence of this big lathe, such as the extremely rigid 4-vee bed; the brand new massive 7½" diameter spindle tailstock; the patented three bearing, triple drive spindle; its 100% anti-friction construction and full automatic oiling.

The many ultra modern and superlative features of "AMERICAN" Deluxe Model Pacemakers are described and thoroughly illustrated by bulletin No. 150. May we send you one?



THE AMERICAN TOOL WORKS CO. Cincinnati 2, Ohio, U. S. A.

LATHES AND RADIAL DRILLS

America's leading ground-to-air defense missile has 3 positioning-flats

LAPOINTE – BROACHED

with unerring accuracy, on the inside of each gimbal ring

Perfectly suited to the newly-designed streamlined Lapointe HP-30 Horizontal Broaching Machine, it's a cinch to broach the three locating flats on these large gimbal rings with the precision required for such internal mounting surfaces in missiles. Production time is good, too — only 60 seconds per ring, floor to floor.

No other broaching machine could do this job so well. And no horizontal broaching machines but Lapointe's have the up-to-date engineering features that are included in this re-designed series. They are built heavy, with plenty of "guts" to do a tough broaching job.

For more than 55 years, Lapointe has been the recognized leader in the art of broaching. Devoting all our effort to this field *exclusively,* industry has been educated over the years to "look to Lapointe" for the most recent improvements in the broaching process. A trained Lapointe Field Engineer may be able to show you how to save on your production costs by converting to Lapointe-Broaching. Why not find out?

EVERYTHING NEW!

A. The new Lapointe HP Series of Horizontal Broaching Machines is available in 9 tonnages, built with special strokes on request. Note the keyed slot for the support pan, a new feature to insure accurate alignment.

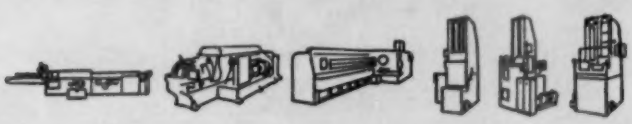
B. Closeup view of special Lapointe-built fixture, and two large gimbal rings before and after broaching.

C. Fabricated broach assembly, 74 inches long, for broaching three pads on the inside of each gimbal ring.

THE LAPOINTE MACHINE TOOL COMPANY

HUDSON, MASSACHUSETTS • U.S.A. *In England: Watford, Hertfordshire*

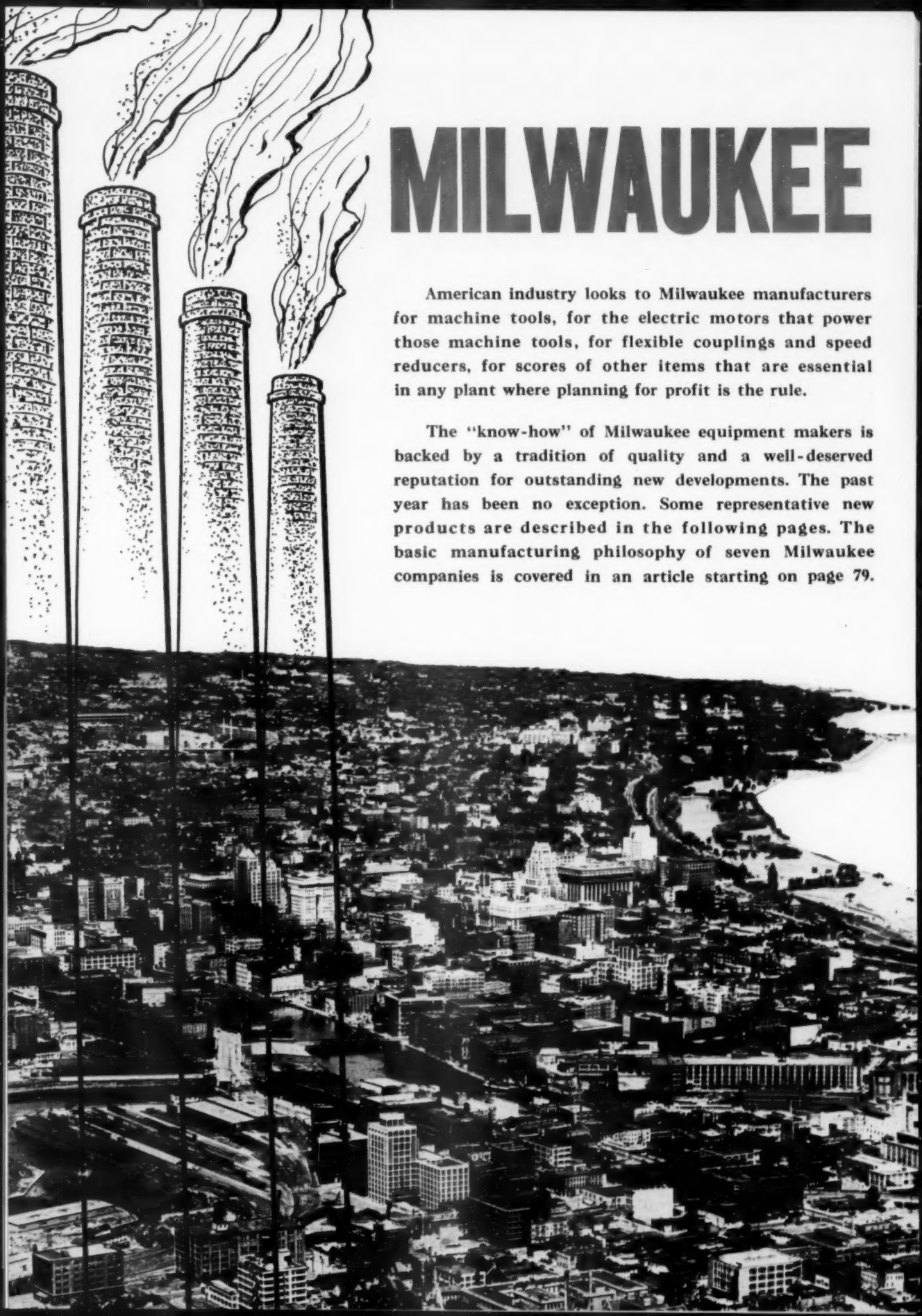
THE WORLD'S OLDEST AND LARGEST MANUFACTURERS OF BROACHING MACHINES AND BROACHES



LAPOINTE

known to be the best in

BROACHING



MILWAUKEE

American industry looks to Milwaukee manufacturers for machine tools, for the electric motors that power those machine tools, for flexible couplings and speed reducers, for scores of other items that are essential in any plant where planning for profit is the rule.

The "know-how" of Milwaukee equipment makers is backed by a tradition of quality and a well-deserved reputation for outstanding new developments. The past year has been no exception. Some representative new products are described in the following pages. The basic manufacturing philosophy of seven Milwaukee companies is covered in an article starting on page 79.

OUR 75TH YEAR
WITH P&H SERVICE

1 P&H ELECTRONICALLY-CONTROLLED CRANES enable operator to handle giant loads quickly, steplessly — to spot them accurately and safely. Amazing control has a simple wiring circuit that replaces 244 heavy-wear parts — cuts maintenance.

2 USER SAVED $25,000 because one P&H Hevi-Lift hoist (left) and hole in the floor eliminated the need for relocating production equipment. Hoist speeds transfer of parts from second floor to finishing line on the floor below.

3 LOW-COST, STANDARD-BUILT CRANE (center) provides cost-saving overhead crane service for handling loads up to 20 tons. It is especially suitable for low-headroom areas.

4 OVERHEAD HANDLING of work-pieces in metal-working operations with P&H Zip-Lift hoist (right) saves time, space, and work — minimizes parts damage. Hoists can be used for in-place or station-to-station handling.

There's money to be made between you and the roof... with P&H cranes and hoists

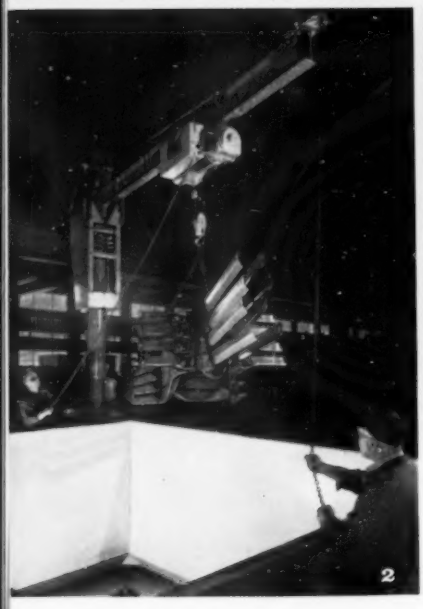
P&H overhead cranes and hoists easily convert idle air-space in your plant into a profitable medium for material movement. You'll find loads move faster, stack higher with overhead material-handling equipment than with floor-bound units. Yes, and you get better utilization of every valuable inch of plant floor-space . . . because you can quickly reach hard-to-service areas . . . actually eliminate excess aisle allowance.

P&H overhead cranes are available for limited or heavy-duty lifting cycles in capacities from 1 to 400 tons or more. Models include an unusually economical standard-built unit whose low cost will pleasantly surprise you. P&H Hoists (sizes from ⅛ to 20 tons) provide you with safe, dependable lifting power in confined areas.

What's more, with each piece of P&H equipment, you get the benefit of 75 years' experience in design, manufacture and application of overhead material handling equipment . . . *plus* the back-up of a service organization that sets the standard for the industry.

That's why, when you plan your next crane or hoist purchase, it will pay you to plan on P&H . . . to protect your investment and your production with equipment built by the world's largest builder of overhead material-handling equipment.

Write today for more information on how your shop or plant can best use P&H Cranes and Hoists. Write for Bulletin C-6 "Industrial Overhead Cranes" and Bulletin H20 on P&H Hoists, Dept. 101, Harnischfeger Corp., Milwaukee 46, Wisconsin.



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3

4

Be sure you visit the P&H plant during the ASTE convention.

P&H HARNISCHFEGER

...quality and service for 75 years

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MILWAUKEE, WISCONSIN

Precision Manufacturers of

- Shaft Mounted Drives
- Motoreducers
- Speed Reducers
- High Speed Drives
- Flexible Couplings
- Special Gear Drives
- Single Helical Gears
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- Marine Drives
- Steel Castings
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- Contract Machining

FALK . . .

a good name in industry

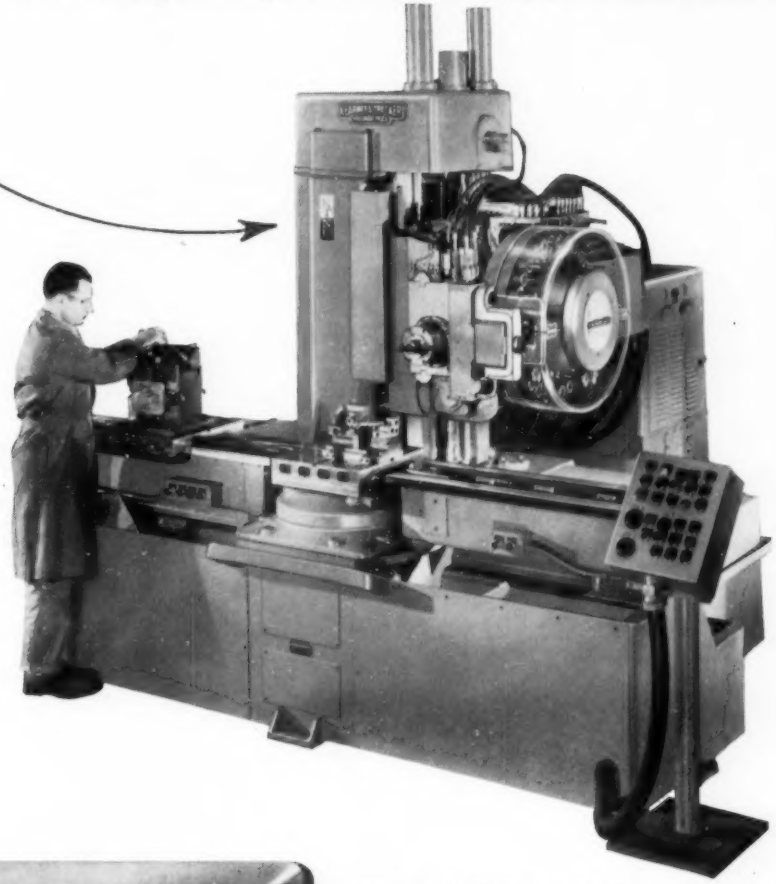
Going to the ASTE Convention in Milwaukee?

Be sure to see the amazing new

KTNC

KEARNEY & TRECKER MILWAUKEE-MATIC

Two nights: April 20 - 21 — make arrangements at our hospitality suite, no. 906, Schroeder Hotel



KEARNEY & TRECKER MILWAUKEE

Designers and Builders of Precision and Production Machine Tools Since 1898

Milwaukee-Matic is a flexible, automated machining center—with automatic tool changer—that unifies milling, drilling, reaming, tapping and boring operations in a single machine.

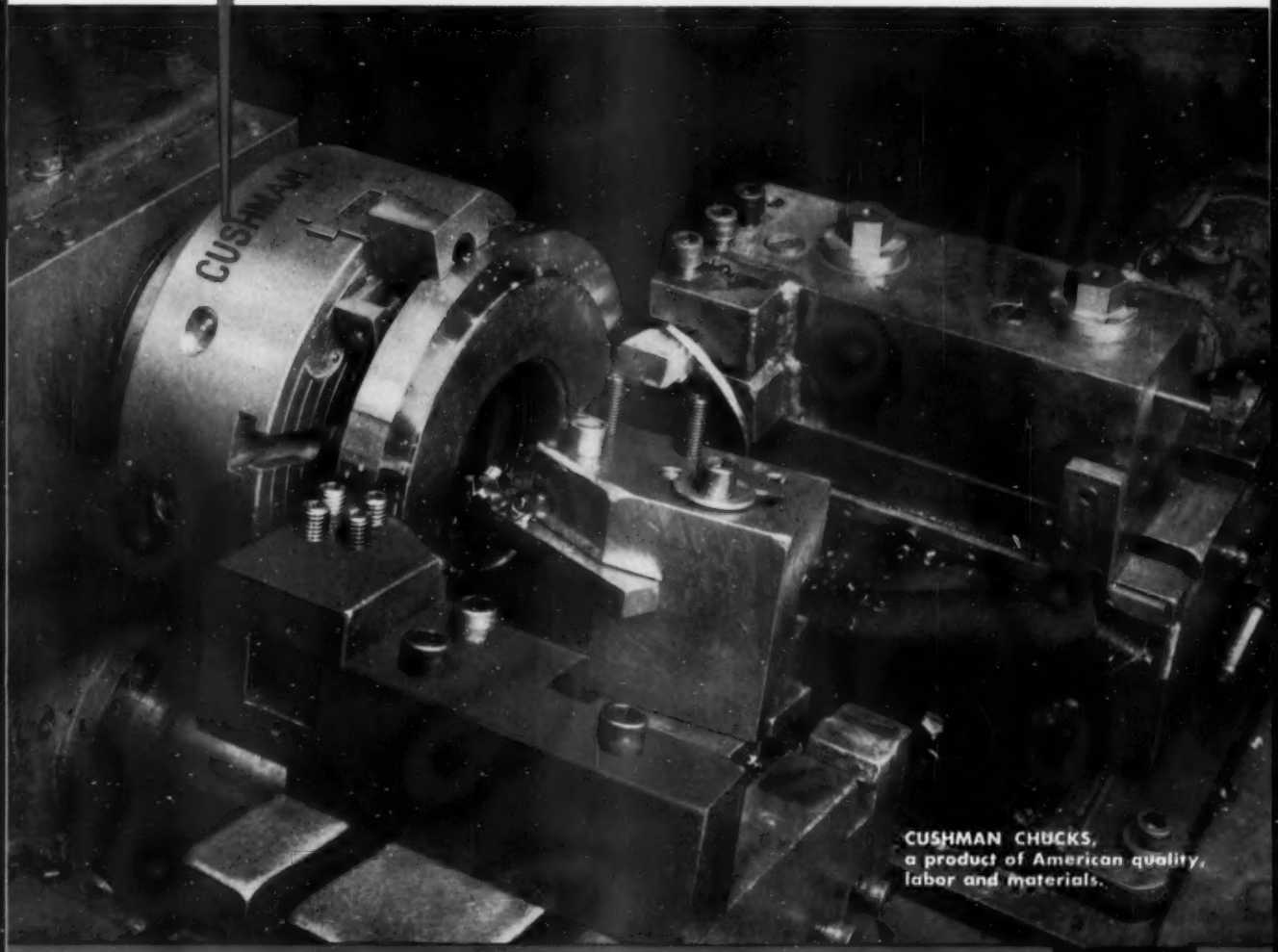
Servo Machine Tool Division
KEARNEY & TRECKER CORP.
6772 West National Ave., Milwaukee 14, Wis.

Beat production quotas and costs with:

Cushman air operated CHUCKING EQUIPMENT

Cushman, the leading manufacturer of air operated chucking equipment, has designed and built a complete line of air operated chucks, cylinders and accessory equipment engineered to meet modern machine tool requirements of heavier feeds at higher speeds, maintain repetitive precision accuracy and positive gripping with truly fast workpiece chucking and unchucking.

Write today for your copy of Bulletin PO-65D and see how you, too, can effectively beat production quotas and lower machining costs by using efficient, economical Cushman Air Operated Chucking Equipment.



CUSHMAN CHUCKS,
a product of American quality,
labor and materials.

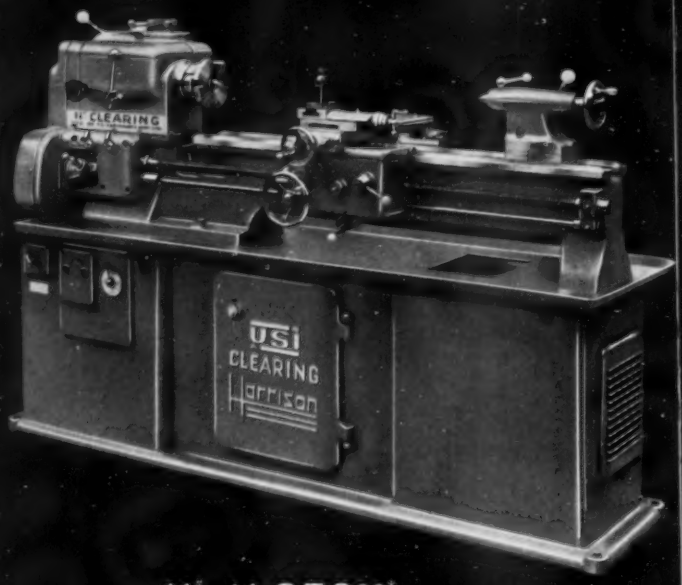
THE CUSHMAN CHUCK COMPANY • HARTFORD 2, CONN.

Sold through industrial distributors

NOW CLEARING THE BIGGEST LATHE

the NEW

CLEARING-HARRISON



11" – $1,950.00*

11", 13" AND 16" COPYING LATHES ALSO AVAILABLE

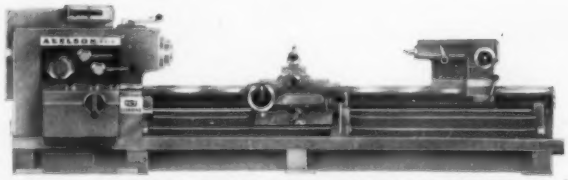
The Harrison line is produced exclusively for Clearing to our specifications. We sincerely believe these to be the finest lathes of their type that can be produced. And their price is at least 30% below the normal price range for machines of this kind.

The Harrison has taper roller bearings in the spindle; hardened and ground ways; precision hobbed, heat treated nickel-chrome gears and a host of features and accessories found only in the most carefully engineered machine tools.

These lathes are readily available from stock at Clearing. Complete stocks of repair parts and accessories are available through Clearing's three plants and at all service centers.

If you are looking for outstanding quality at a low, low initial cost, be sure to investigate the Clearing Harrison. It's the nation's greatest lathe value.

Clearing, division of U. S. Industries, Inc., also manufactures the Axelson line of engine lathes, power presses of all types, dies and special tooling, and special equipment for the aircraft and missiles industry.



Shown, the new all-steel Clearing-Axelson lathe, Model 2516

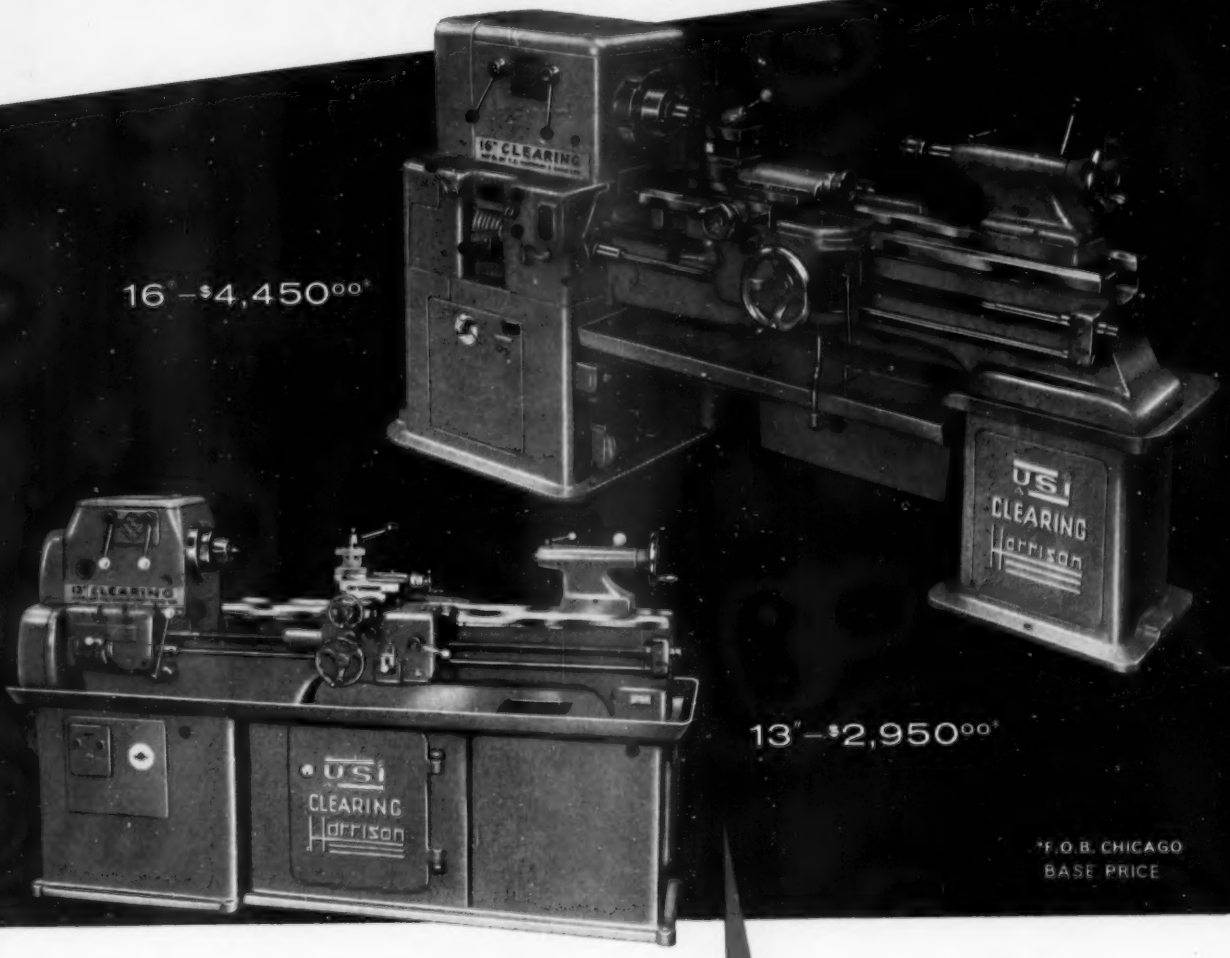
USI Clearing

DIVISION OF U. S. INDUSTRIES, INC.

6499 W. 65th Street • Chicago 38, Illinois

Plants in: Chicago, Ill. • Hamilton, Ohio • Los Angeles, Calif.

BRINGS TO AMERICA VALUE *EVER!*



16" – $4,450.00*

13" – $2,950.00*

*F.O.B. CHICAGO
BASE PRICE

Coast to Coast Service Facilities

Clearing's nationwide facilities assure you of prompt service always. Replacement parts and accessories are stocked at Clearing and are available through all three plants, at all service centers and through all Clearing dealers.

I'm interested. Send full particulars on Clearing's Harrison line.

Name_____

Title_____

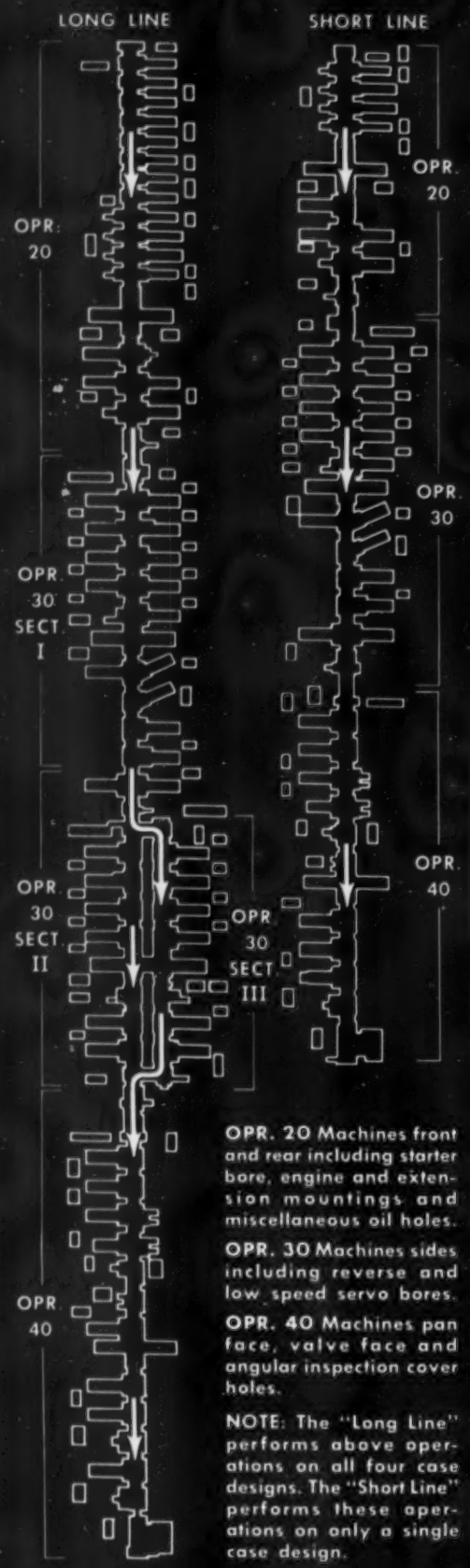
Company_____

Street_____

City_____ Zone____ State_____

SEE YOUR DEALER FOR AN
ON-THE-SPOT DEMONSTRATION

Complete Product Mix Processed On New Cross Transfer-matics



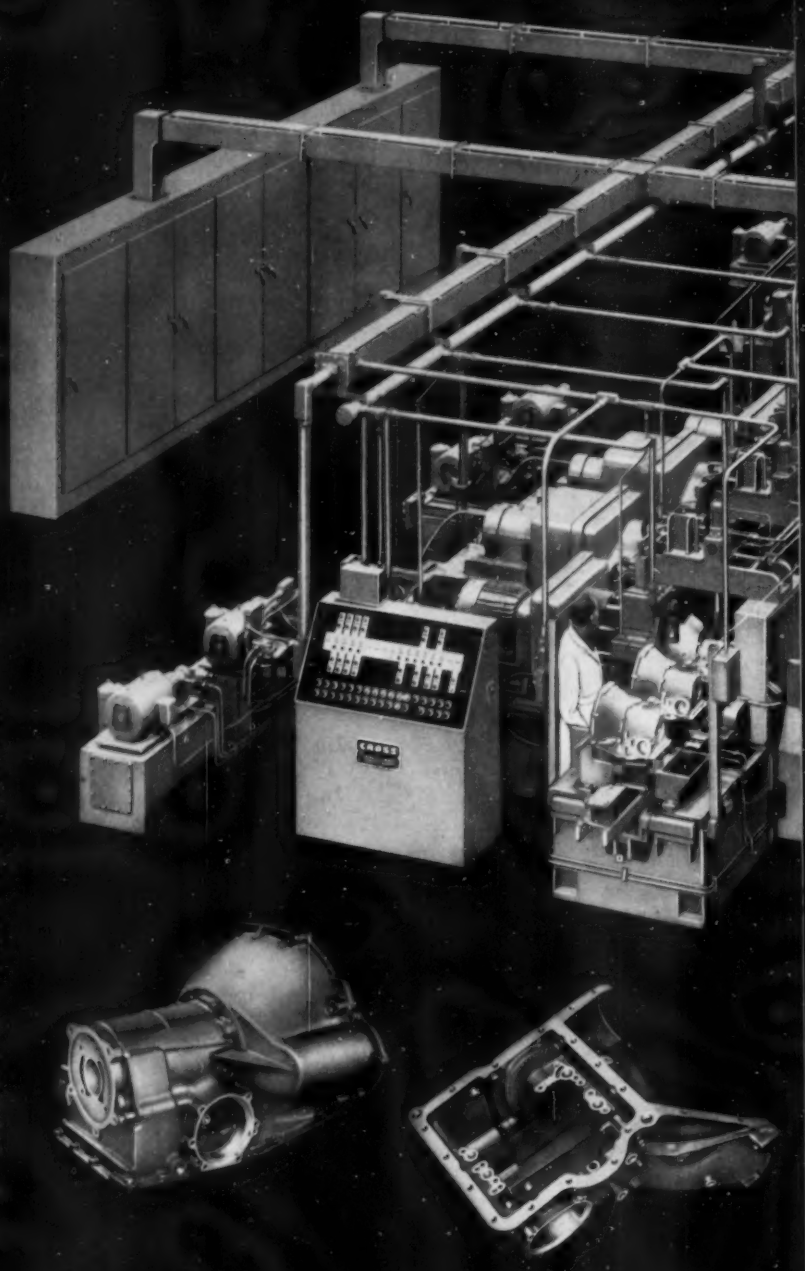
OPR. 20 Machines front and rear including starter bore, engine and extension mountings and miscellaneous oil holes.

OPR. 30 Machines sides including reverse and low speed servo bores.

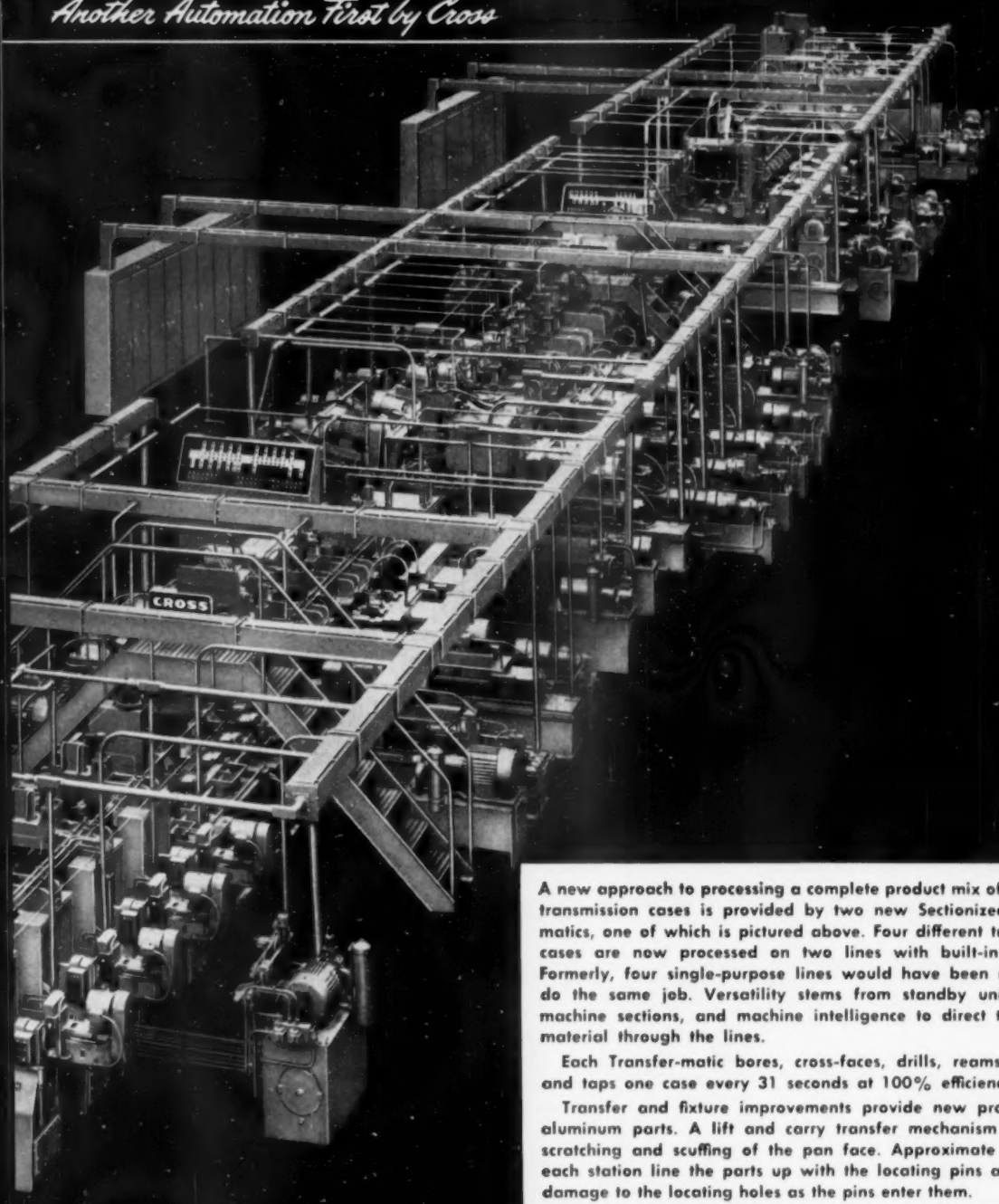
OPR. 40 Machines pan face, valve face and angular inspection cover holes.

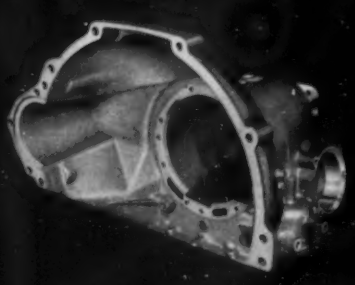
NOTE: The "Long Line" performs above operations on all four case designs. The "Short Line" performs these operations on only a single case design.

Floor Plan Layout of Two New Cross Sectionized Transfer-matics



Another Automation First by Cross





A new approach to processing a complete product mix of aluminum transmission cases is provided by two new Sectionized Transfer-matics, one of which is pictured above. Four different transmission cases are now processed on two lines with built-in flexibility. Formerly, four single-purpose lines would have been required to do the same job. Versatility stems from standby units, off-line machine sections, and machine intelligence to direct the flow of material through the lines.

Each Transfer-matic bores, cross-faces, drills, reams, chamfers and taps one case every 31 seconds at 100% efficiency.

Transfer and fixture improvements provide new protection for aluminum parts. A lift and carry transfer mechanism eliminates scratching and scuffing of the pan face. Approximate locators in each station line the parts up with the locating pins and prevent damage to the locating holes as the pins enter them.

Down time is minimized by use of "static" controls since conventional relay maintenance is virtually eliminated. Programmed tool changes with Cross Toolometers and Machine Control Units and a machine communications network facilitate "combined" tool and machine maintenance.

Sectionized machine design insures peak output by feeding parts into the machine behind "down sections."

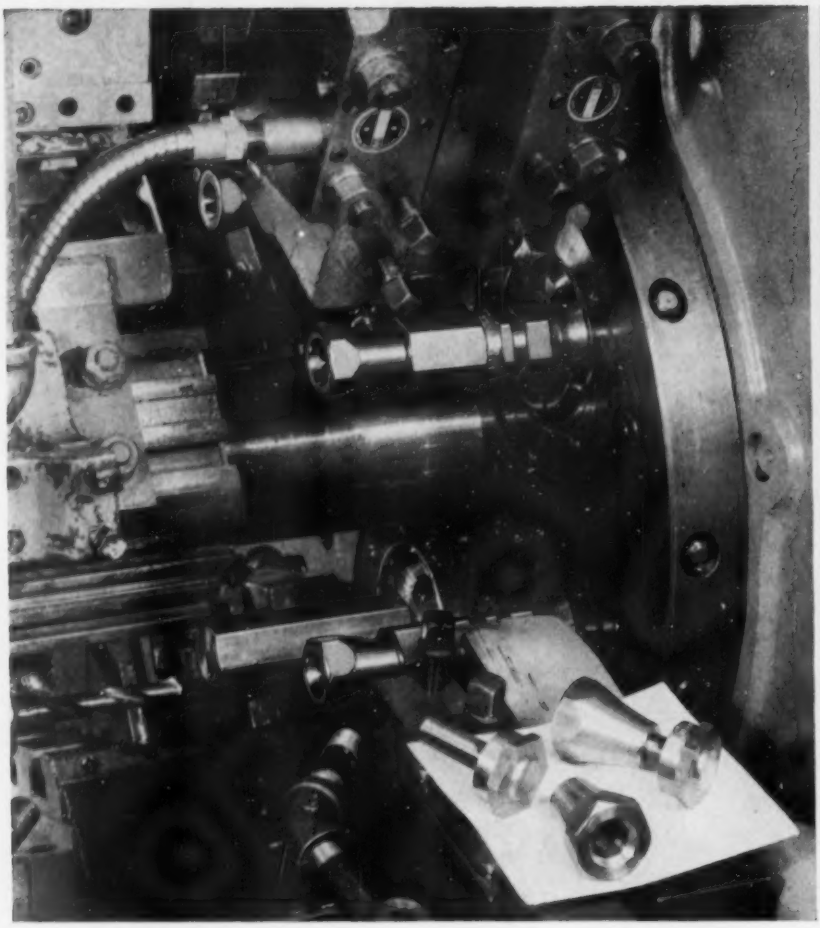
The Cross "building block" principle and optimum standardization assure highest flexibility for part design changes or re-application of machine units for entirely new part processing.

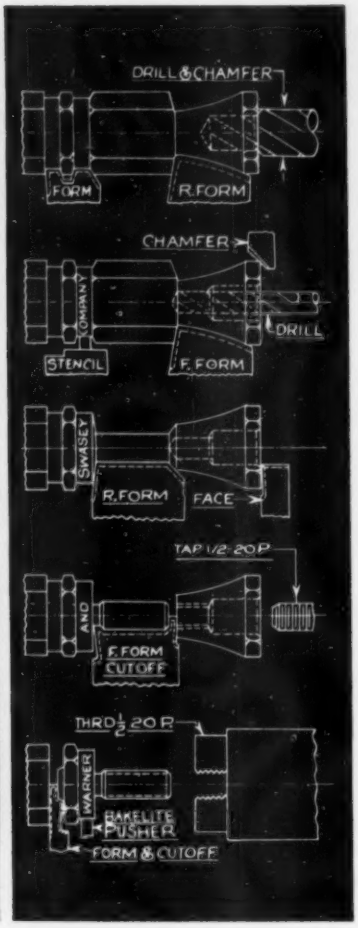
Established 1898

THE **CROSS** CO.

First in Automation

PARK GROVE STATION • DETROIT 5, MICHIGAN





Warner & Swasey 5-Spindle Automatic produces complex 2-piece job in one cycle!

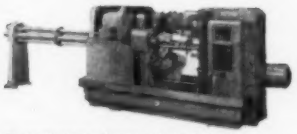
THIS JOB demonstrates the versatility of the Warner & Swasey 5-Spindle Bar Automatic in producing complex jobs that also require heavy metal removal ability.

This machine can produce both parts of this jack screw almost simultaneously. After taking the form cuts, one piece is tapped and cut off in the fourth position, and the second threaded and cut off in the fifth position. The entire operation — 43.4 seconds!

The 5-Spindle Automatic's longitudinal slide with 5 tooling stations and the 2 auxiliary slides provide a total of 7 end-working tool positions. Add 5 independent cross slides, including the cut-off slide, and you have a total of 12 tooling stations for the 5 spindles. High-speed drilling attachments can be mounted in all positions —and threading, tapping and reaming attachments are available for the third, fourth and fifth positions, if required.

Camless design of the 5-Spindle Automatic provides quick changes of all strokes, and feeds and speeds. Strokes are quickly set with the patented quadrant control mechanism, using simple linear scales. Speeds are changed by quick change gears and feeds by shifting sliding gears in the feed box.

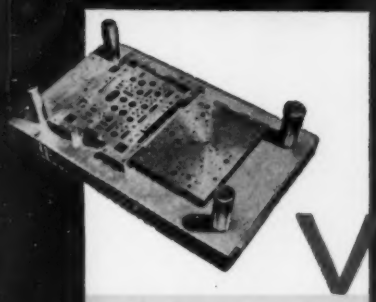
On complex jobs like this, and many simpler ones, the quick setup of Warner & Swasey Multi-Spindle Automatics will pay off for you—even on medium and small lot work. To find out more about the adaptability of these machines to your own work, call in your Warner & Swasey Field Representative.



5-SPINDLE BAR MACHINE
1¾" Standard Bar Capacity
2¼" Oversize Capacity
5-SPINDLE CHUCKING MACHINE
6" Swing
6-SPINDLE BAR MACHINE
1¼" Bar Capacity

WARNER & SWASEY
Cleveland
PRECISION MACHINERY SINCE 1880

YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS...WITH A WARNER & SWASEY



vega®

is a tough air-hardening tool and die steel that saves money and time by virtually eliminating the fitting and adjusting of dies after hardening. Its ability to resist distortion and size change is the most dependable in the industry. VEGA is the only steel that combines the machining properties of an oil-hardening grade with the safety in hardening normally found in air-hardening steels.

Prove it to yourself. Call your local Carpenter SERVICE-CENTER today for immediate delivery.

the *Carpenter* Steel Company, Reading, Pa.

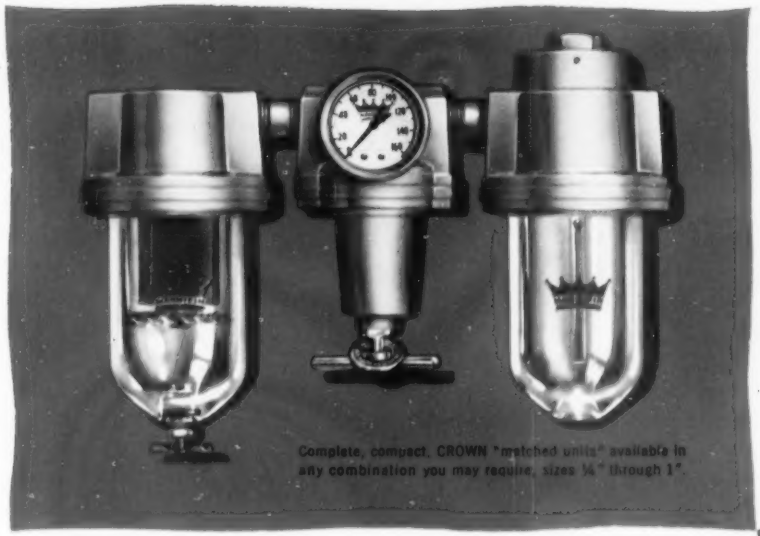
When you "Put it on the Blanchard"
. . . be sure to use Blanchard Wheels

Your Blanchard Surface Grinder is designed to give you peak production and economy on hundreds of different grinding jobs. But, for every job you run, *there's one particular wheel that does it best!* That's why Blanchard manufactures and stocks a wide variety of silicate, resinoid and vitrified bonded wheels and segments.

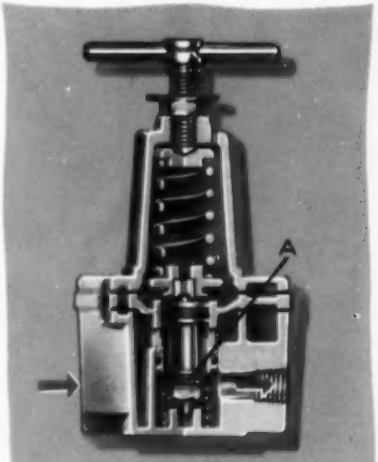
Your Blanchard representative will be glad to help you select the wheel—or wheels—best suited to *your* grinding operations. Call or write him today. May we send you a copy of "The Art of Blanchard Surface Grinding" (4th Edition)?

THE BLANCHARD MACHINE COMPANY
64 State Street — Cambridge 39, Mass., U.S.A.

Crown From HANNIFIN air preparation units that don't waste air power



Complete, compact, CROWN "matched units" available in any combination you may require, sizes ¼" through 1".



Hannifin regulator design enables oversized poppet (A) to open to full-pipe capacity in a very short stroke. Direction of flow eliminates chatter. Standard models self-venting.

Hannifin CROWN "Combo" units – filters, regulators and lubricators in any combination – keep compressed air in the "pink of condition" without depriving you of needed air flow.

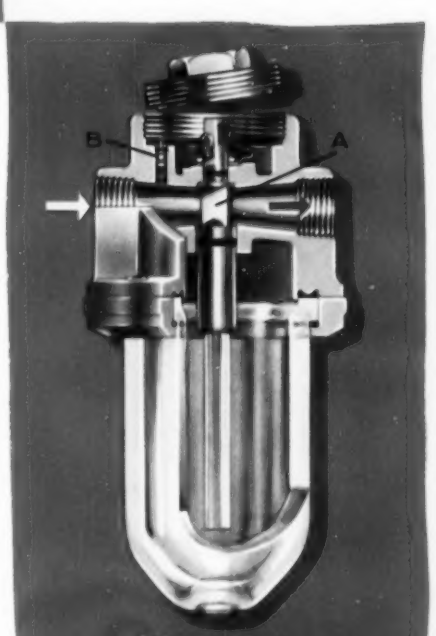
Crown regulators open fast on demand, close precisely when demand is satisfied, deliver the exact amount of air needed. Their "piston balanced" poppet design, which makes possible a flat, large-area, poppet-type valve with very short stroke, is the reason. The inherent stability of this design – no hunting or chatter – results in multi-million cycle life.

Crown filters have large, reusable filter elements for minimum resistance to air flow. Crown lubricators introduce predetermined amounts of oil into the air stream, automatically. Their design is so responsive to variations in air flow rate that the concealed, tamperproof adjustment is rarely used. This is the easiest lubricator of all to fill, and remote-fill models are available.

Crown units are competitively priced and stocked in principal industrial areas by Hannifin CROWN authorized distributors. For CROWN literature and the name of the distributor nearest you, write:

HANNIFIN COMPANY

535 South Wolf Road • Des Plaines, Illinois



Lubricator vane (A) is factory pre-set for most applications. Valve (B) shuts off air pressure to bowl when fill plug is removed. This patented Hannifin feature permits bowl refill without shutting down air line.

Can parts this small be barrel finished?

Dime shows relative size of typical bearing races.

EMPHATICALLY, YES!
For example, precision deburring and finishing of small parts with ALMCO barrel finishing equipment is an important operation at the modern new plant of Miniature Precision Bearings, Inc., Keene, N. H.

M.P.B. makes miniature ball bearings, some with assemblies so tiny that 500 can be carried in a thimble. ALMCO precision barrel finishing equipment and methods are used to improve surface finish on the inner and outer races, as well as removing burrs, sharp edges and machining lines.

Production usually runs from 1,000 to 4,000 parts per load, and occasionally at from 5,000 to 15,000 parts per load. All told, millions of parts annually are finished the ALMCO way at Miniature Precision Bearings!

If you have a finishing problem with your parts, small *or* large, perhaps ALMCO has the answer. It's easy to find out. Just write us on your letterhead asking for an ALMCO sales engineer to call. He will arrange for your product parts to be run through detailed sample processing to determine what combination of machine, compound, media, cycle, etc., will produce the results you want, at lowest possible cost.

Or, if you prefer, send sample parts and specifications on results desired direct to ALMCO's main laboratory at Albert Lea, Minnesota.

SEND FOR FREE 52-PAGE BOOK . . .

Modern precision barrel finishing processes completely described. 52 pages of facts, photos, data and cost comparison charts. Send for your free personal copy today.

ALMCO

Queen Products Division • King Seeley Corporation
184 E. Main Street • Albert Lea, Minnesota

Sales and Engineering Offices in Chicago, Detroit, Los Angeles, Newark, New Haven and Philadelphia

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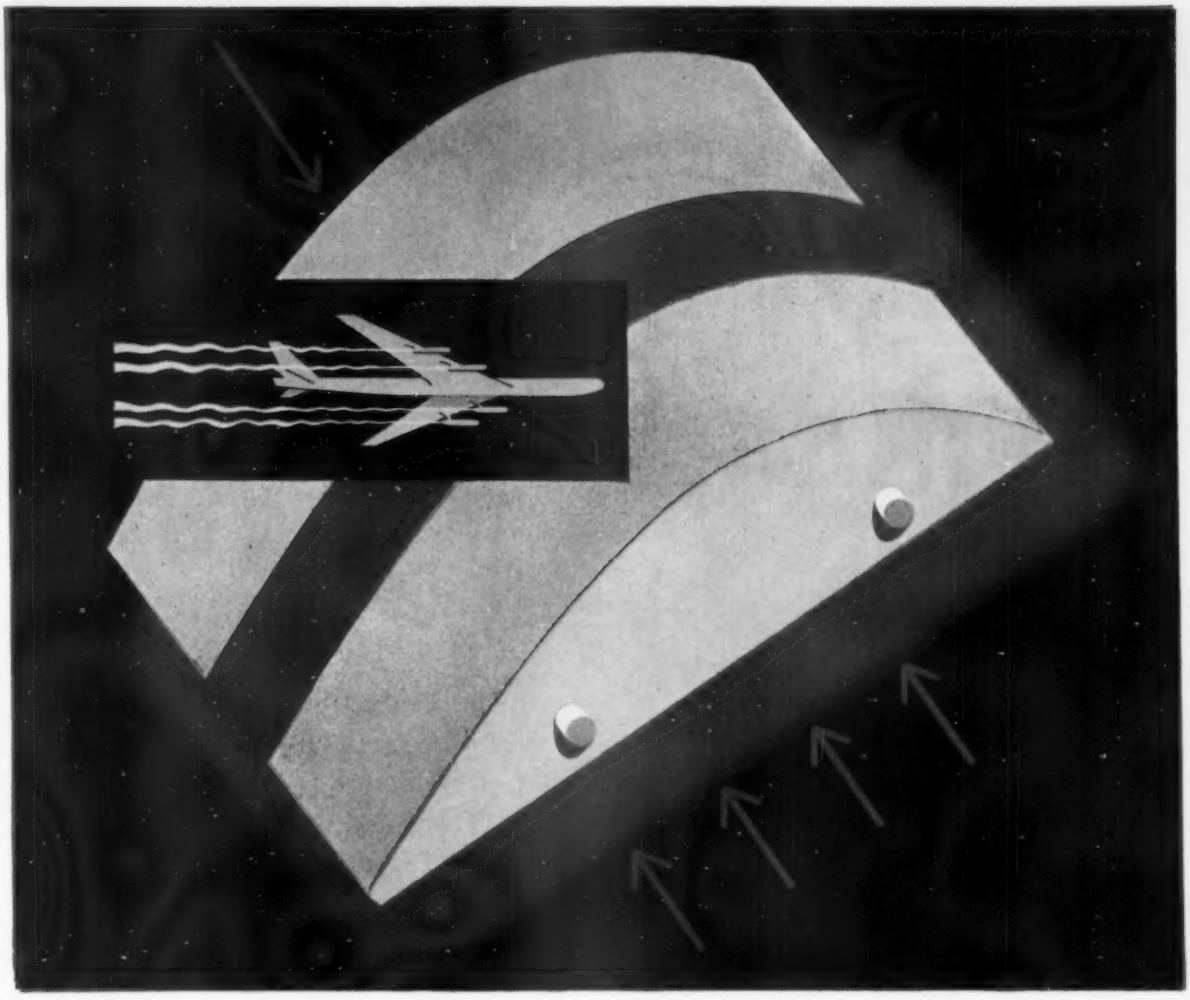


Save up to 30% in cost, 60% in time with **EPON® RESIN** tools and dies

Your tooling resin formulator will show you how Epon resin formulations save time and money in applications such as these:

High temperature tooling: Metal forming stretch dies that can operate at temperatures over 400°F.

Heated tools: Matched dies, with integral heating units, may be made with Epon resin formulations for rapid heat curing of laminated plastic parts.

Long-lasting metal forming tools: Castings made of formulated Epon resin, mounted in a crank press, showed no permanent deformation after 28,000 compression-shock cycles.

In addition, Epon resin formulations offer you the following advantages:

Excellent tolerance control: Little machining and handwork are required to finish Epon resin tools because of the material's excellent dimensional stability and lack of shrinkage.

Outstanding strength: Jigs and fixtures with thin cross sections can be built from Epon resin-based formulations reinforced with glass cloth. The resulting laminate has high flexural strength and excellent dimensional stability.

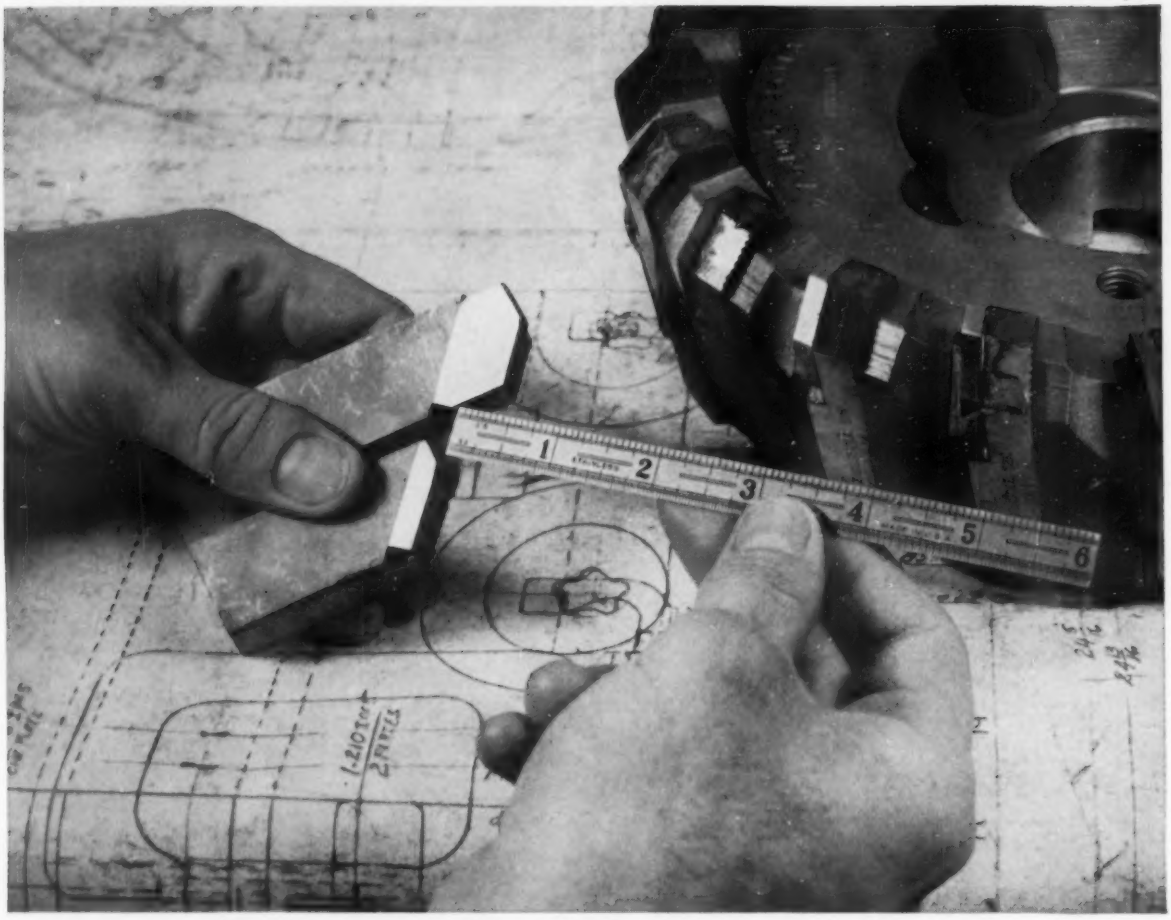
Easy modification: Tools and fixtures made from Epon resins may be quickly and easily modified to incorporate design changes.

CONTACT YOUR TOOLING RESIN FORMULATOR

The combination of resin formulator's skill and practical knowledge, backed by Shell Chemical's technical research and experience, has solved many important tooling problems for industry. Your own formulator specialist can help you solve yours. For a list of experienced tooling resin formulators and additional technical information, write to:

SHELL CHEMICAL CORPORATION
PLASTICS AND RESINS DIVISION
50 WEST 50th STREET, NEW YORK 20, NEW YORK
CHICAGO • CLEVELAND • LOS ANGELES • NEW YORK
IN CANADA: Chemical Division, Shell Oil Company of Canada, Limited, Montreal • Toronto • Vancouver

SHELL



Ingersoll Heavy-Duty Shear Clear Face Mill designed for cast iron or steel. Size of bevel is varied to suit depth of stock.

What Does Your Scrap Barrel Show?

Do you get over ½" of blade wear? A look into your scrap barrel will show that many blades were wasted because of cracks, misuse, improper design or misapplication of the cutter and grade of carbide. You probably can't tell why these blades failed prematurely because so many variables are involved.

We are used to working with these variables and can help you reduce your tool costs. Part of our product is the continuous counsel of your Ingersoll representative and our cutter engineers. They will consider the machine, material, speed, feed and finish requirements before recommending the tool which will do the best job at the lowest cost.

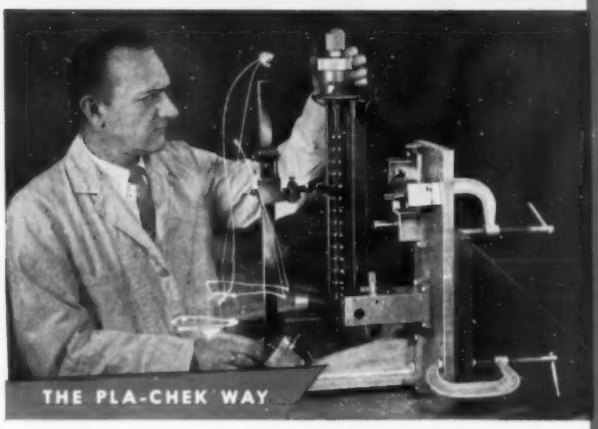
We will welcome an opportunity to tell you more about this service. Write:

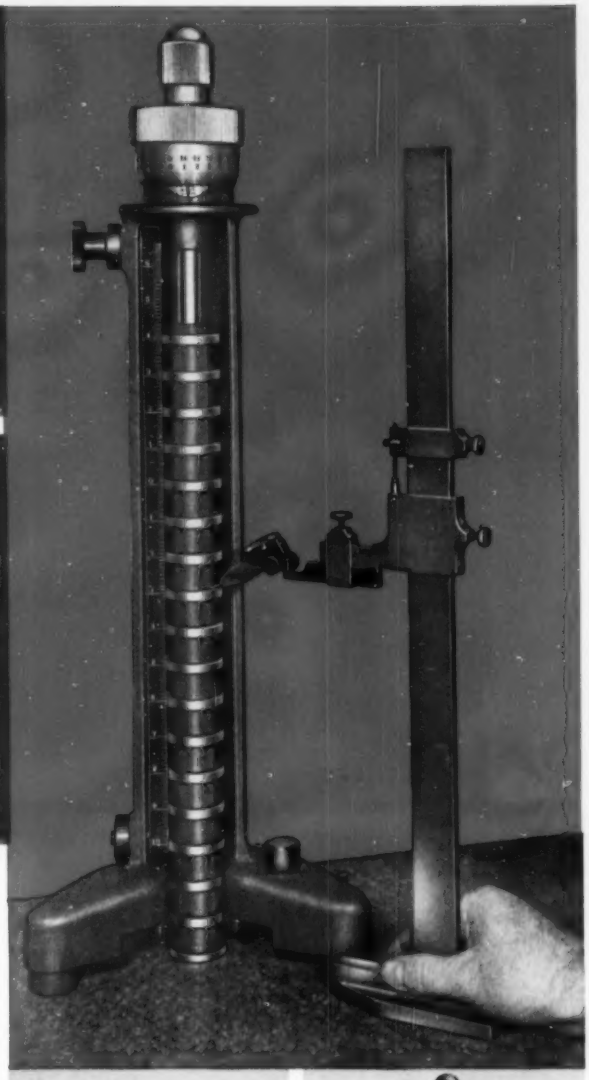
If you do not have a copy of this book, write us and we will send you one. It describes in detail the complete line of Ingersoll inserted blade milling and boring tools. Ask for Catalog 666

CUTTER DIVISION

THE INGERSOLL MILLING MACHINE COMPANY

505 FULTON AVENUE ROCKFORD, ILLINOIS





See How PLA-CHEK Cuts Inspections from Minutes to Seconds

Notice the wrist light photos above. Just a turn of the Micrometer thimble and PLA-CHEK is set. Far fewer motions, far less time . . . and guaranteed accuracy to .00005″ throughout this PLA-CHEK'S entire range. No gage blocks or reference surfaces to touch—body heat can't affect it. Setting time 10 seconds . . . inspections in 1/5 the time of older methods. That speed and accuracy is being proved daily in thousands of installations throughout industry.

There are many other time-saving and money-saving features of PLA-CHEK Gages. Let us tell you about them. Write for complete, detailed literature.

COMPLETE RANGE OF SIZES

PLA-CHEK Gages are available in a full range of sizes to meet every inspection or surface plate layout requirement. Models are: The easily portable 6″ and 12″ sizes and the 18″ size (shown above) are guaranteed accurate to .00005″ throughout their entire range, and the 24″, the 36″ and the 48″ sizes are guaranteed accurate to .0001″ in any 24″ length or .0002″ over their entire range.

PRECISION RISERS

Built with the same precision as the gages themselves, PLA-CHEK Gage Risers may be used to extend the usefulness of every PLA-CHEK Gage from the smallest to the largest size. Available in 6″ height for 6″, 12″, 18″ PLA-CHEKS . . . 12″ height for 24″, 36″, 48″ models.

MICROMETER THIMBLE

Is graduated to .0001″ and provides dimensions between 1″ steps on measuring bar. Measuring bar of the 18″ model (as illustrated) and larger models, can be adjusted to enable the user to take readings up or down relative to a center line or other reference line on the work.

Cadillac GAGE COMPANY

P. O. BOX 3806 • DETROIT 5, MICHIGAN

From the Report — A Typical Cylindrical Job

Page 6 On a crush-truing job in Indiana, a 20 x 2 x 12" wheel was used . . . for grinding . . . a machine spindle. The material was about Rockwell C48 . . . when a wheel of 32A120-N9VG (32 ALUNDUM — G bond) was put on the job, the operator reported he could get 4 times as many pieces per dressing before the wheel face began to lose its shape, and yet there was no trace of burn.

Hot off the press!

From Norton to you

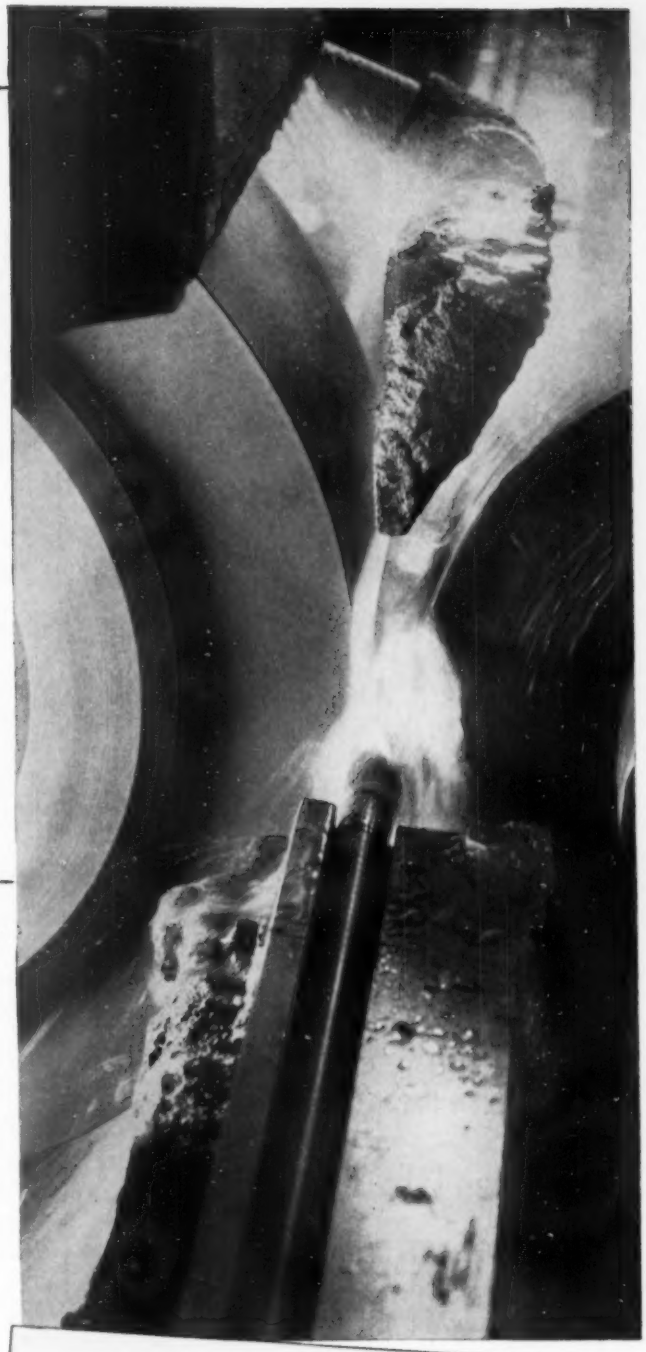
Join the nation-wide progress now being made in every type of O.D. grinding! The new Norton publication, *A Report on O.D. Grinding*, tells you how.

Based on extensive service by helpful Norton Men, this Report brings you many valuable new solutions to O.D. problems . . . describes "tricks of the trade" that get the most out of cylindrical and centerless machines . . . provides on-the-job performance of different grinding wheels in different applications . . . and analyzes the following highly efficient abrasives and bonds.

Abrasives. 44 ALUNDUM* (aluminum oxide) abrasive, an ideal cost-cutter for many O.D. jobs. 32 ALUNDUM abrasive, top-quality for grinding various materials, including harder steels. The other time-tested Norton ALUNDUM abrasives are also included. And 37 and 39 CRYSTOLON* (silicon carbide) abrasives are best-suited for grinding cast-iron, non-ferrous metals, carbides and other materials.

Bonds. G bond, biggest advancement in vitrified bonds, gives best results in most O.D. jobs, particularly crush-truing. Vitrified BE bond is

An Up-To-The-Minute Report *filled with* Inside Facts on Outside Grinding



another widely-used favorite. Where CRYSTOLON abrasive is required, K bond is outstanding. B11 resinoid bond excels in uniformity with both ALUNDUM and CRYSTOLON wheels. For centerless feed wheels, R51 rubber bond assures complete regulating control without slippage.

Your Norton Man will be glad to work with you in determining just what improvements in grinding methods and wheel selection will assure you the lowest cost-per-piece produced. More news about how this expert can bring the value-adding, profit-boosting "Touch of Gold" to your production is stated in the Report. Your copy of this Report is available from your local Norton Representative . . . and is as near as your phone. Call for it today. NORTON COMPANY, General Offices, Worcester 6, Mass. Plants and distributors around the world

From the Report — A Typical Centerless Job

Page 6-7. On a centerless operation involving heavy stock removal from 2" diameter bars 4' long, 44A54-MVBE (44 ALUNDUM — BE bond) has been reported to be the best wheel specification they have ever used. It cuts faster, cooler and requires less truing than any other vitrified wheel . . . is priced much lower than resinoid or rubber bonded wheels.

NORTON ABRASIVES

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

W-1900

Making better products . . . to make your products better

NORTON PRODUCTS Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals — BEHR-MANNING DIVISION Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

LATROBE Metalmasters . . .

working for you through BETTER High Alloy Die Steels

Fully-uniform
DESEGATIZED®
High Alloy Die Steels

- OLYMPIC FM
- BR-4 FM
- GSN FM
- COBALT CHROME FM

. . . for long-run dies!

Users of Latrobe's 12% chromium die steels pave the way toward greater production economy. Why? Because, as a result of Latrobe's exclusive DESEGATIZED® process, these steels are free of harmful carbide segregations —fully-uniform to insure maximum die results. Containing evenly-dispersed alloy sulphides, they are easier to machine . . . easier to work!

Put Latrobe Metalmasters to work on your long-run dies through using DESEGATIZED® High Alloy Die Steels . . . steels made by Metalmasters who *know* your production die requirements!

Call your Latrobe representative today!

LATROBE STEEL COMPANY

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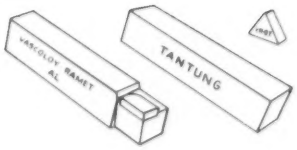
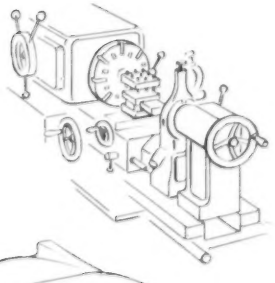
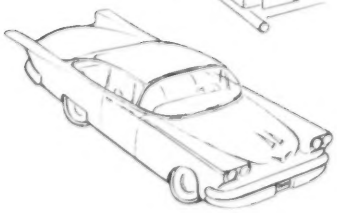
Research...
in metals of tomorrow

V-R

FROM METALS...TO MACHINING...TO FINISHED PRODUCTS







The V-R carbides, Tantung and ceramics you use today are the result of yesterday's V-R research. These special refractory metals are helping industry produce thousands of better finished products at lower cost to provide a higher standard of living for everyone.

Today's V-R research will mean even better metals for better machining on your improved products of tomorrow. That's why V-R research is working full time to produce the metals of tomorrow today.

The vast knowledge acquired through Vascoloy-Ramet Corporation's 29 years of research, design and manufacture of refractory metals is your assurance of continued progress in metals for machining . . . it's our way of helping to increase human productivity and reduce machining costs.

Vascoloy-Ramet Corporation

V-R

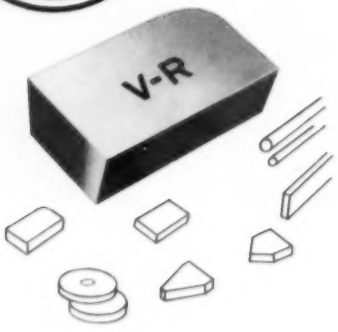
V-R Carbides . . . . .

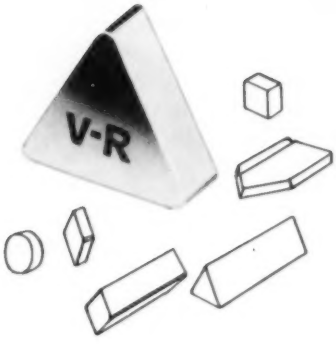
Why doesn't carbide produce equally phenominal results on all applications? The answer is quite simple . . . the carbide required for one job may be entirely different than that required for another job. Best results can be obtained only by engineering the carbide to meet the problems of each type of application.

Here's the point . . . you wouldn't specify 1020 steel for a job requiring a nickel-chrome 3140. Similarly, the proper carbide grade is determined by the specific cutting problem. A vast knowledge of metallurgy and years of experience in refractory metal production techniques enable V-R to build exactly the right combination of characteristics into each carbide grade to do a specific job. These characteristics of the many V-R carbide grades can vary as much as the characteristics of the steel you use.

V-R research has developed carbide grades for maximum cutting efficiency in practically any application and V-R Production Engineers have worked with thousands of cutting problems to fit the right carbide to the job. Put this experience to work solving your problems. Just contact your nearest V-R representative or send us the details of your applications.

V-R BLANKS · BRAZED & SOLID TOOLS · INSERTS





VR CARBIDE BLANKS

A wide range of styles and sizes, available in a variety of carbide grades, means carbide blanks to fit almost any application. Widely used for making tools and parts such as tipped cutting tools, solid tools, reamers, guides, lathe centers, circular saws, instrument parts, bearings, bushings and for thousands of special parts requiring extreme resistance to wear, high temperature and corrosion.

VR CARBIDE TOOLS

Standard tools with brazed carbide tips and solid carbide tools for all types of cutting operations such as turning, facing, chamfering, threading, grooving, boring and milling. V-R also manufactures a wide range of non-standard tools for special operations. Your V-R representative will be glad to work with you to provide you with the right tool for any application.

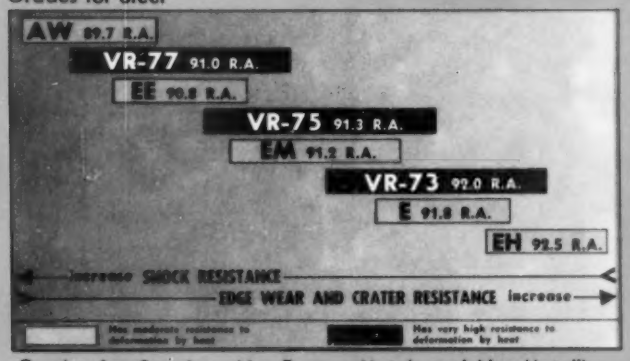
VR CARBIDE INSERTS

Complete line of cemented carbide inserts for operations performed with mechanical toolholders. Includes inserts for both negative and positive rake toolholders; throw-away, 1½" length and heavy duty inserts. Each style is available in a wide range of carbide grades giving you exactly the right combination of insert style and grade to meet the requirements of any job.

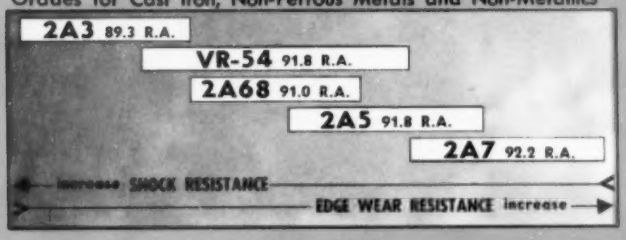
. engineered for the job!

CARBIDE GRADE SELECTION GUIDE

Grades for Steel



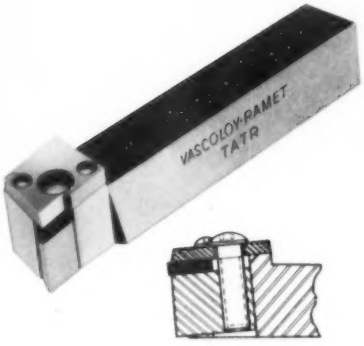
Grades for Cast Iron, Non-Ferrous Metals and Non-Metallics

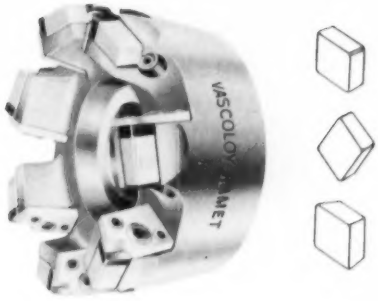


Carbide Grades

The type of operation performed and the material to be machined dictate the required characteristics of the correct carbide grade for any specific application. These factors will determine the relative importance of shock resistance, heat resistance and edge wear and crater resistance of the carbide. That's why V-R research and production engineers have developed 14 standard carbide grades . . . to provide the right combination of characteristics for practically every application. Other V-R carbide grades have been developed to meet highly specialized applications. Use the handy carbide grade selection guide at the left to determine the proper V-R standard grades for your various jobs. Write for V-R Bulletin No. 5803.

• TOOLHOLDERS • FACE MILL CUTTERS & INSERTS





TOOLHOLDERS Elevator Type

Includes all styles of negative rake for throw-away inserts and inserts up to 1½" length . . . positive rake for throw-away inserts. Features amazing simplicity for adjusting, indexing or changing inserts because the insert is clamped between an adjustable elevator and a fixed position chipbreaker plate. No parts to be removed or to fall out even when toolholder is in inverted position.

TOOLHOLDERS Solid Base Type

Complete range of negative rake and positive rake styles for throw-away inserts. Also includes heavy duty negative rake toolholders for turning and facing. A positive-grip screw and clamp arrangement holds the carbide chipbreaker and insert against the solid base. The solid base has a carbide shim which helps minimize damage in case of excessive pressure.

FACE MILL CUTTERS

You change only the carbide insert . . . not the cutter body. Saves downtime, cuts carbide costs and eliminates carbide grinding. Available in negative rake with square insert and 80° diamond inserts and neutral rake with square inserts. Sizes from 4" to 12" diameter for both spindle nose mounting and style "C" arbor mounting.

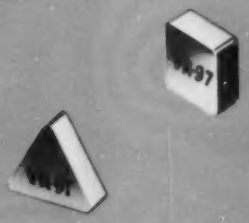
TANTUNG® cast alloy

V-R TANTUNG bridges the gap between maximum cutting speeds of high speed steel and practical minimum speeds of cemented carbides . . . and it's easy to grind with aluminum oxide wheels.

High red-hardness, high transverse rupture strength, low coefficient of friction and high shock resistance are a few of the characteristics which make TANTUNG the ideal tool material for intermediate cutting speeds.

TANTUNG tools are available in a variety of shapes and sizes to cover all types of operations . . . such as turning, facing, chamfering, cut-off, grooving, boring, milling and forming. TANTUNG tools are often used to great advantage in combination with V-R carbides when two or more operations are performed simultaneously at different surface speeds. Ask your V-R representative about TANTUNG cast alloy and how it can cut costs for you in multiple tooling set-ups.

CERAMIC VR-97



CERAMIC VR-97 is an entirely new aluminum oxide cutting material for ultra high speed machining. It's stronger and will outwear any other ceramic because of its high purity and exceptional uniformity. Speeds of 1,000 to 2,000 surface feet per minute or higher are recommended because ceramic VR-97 performs best on continuous cuts at ultra-high speeds. Available in inserts for negative rake toolholders.

MODERN FACILITIES FOR THE BEST IN REFRACTORY METALS

From the modern plant where V-R refractory metals are designed and manufactured . . . to your V-R field service man . . . to your local V-R representative . . . nothing is overlooked to provide you with the service and quality products which help you reduce machining costs. Discuss your cutting problems with the V-R representative in your area. You will soon learn how V-R service to industry can be put to work for you.

• Indicates V-R service men, sales representatives and distributors. Wherever you are located, there's a V-R representative nearby.

Vascoloy-Ramet corporation

PRIME MANUFACTURERS OF REFRACTORY METALS ENGINEERED FOR THE JOB.

800 Market Street • Waukegan, Illinois

A-735 4-1-59

Printed in U.S.A.

How to tell which carbide tool will give you the most production

When you see the name Staples on any carbide-tipped or solid carbide tool, you may be sure that you have purchased a cutting tool specifically designed for high production potential.

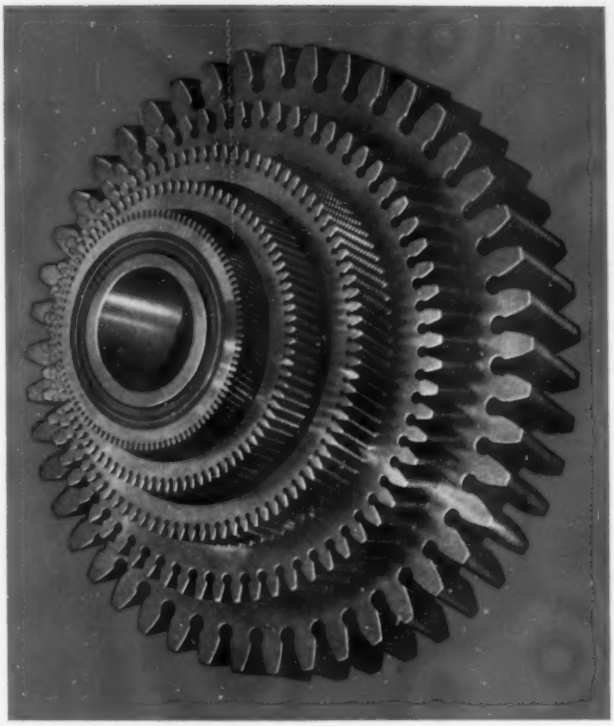
For behind this name is over twenty years experience in manufacturing accurate and economical cutting tools. Tools that meet the demand of today's higher speeds and feeds.

Service is another thing you will like about dealing with Staples. Example: Upon request – in just 48 hours – we will ship stock carbide reamers and core drills ground to your specified diameters. And you will receive prompt quotations on "special" carbide tools made to your specifications by skilled Staples craftsmen.

Staples
ROTATING CARBIDE TOOLS

THE Staples TOOL COMPANY
2352 GLENDALE-MILFORD ROAD, CINCINNATI 15, OHIO

WHY RED RING GEAR SHAVING CUTTERS DO SUCH AN EXCEPTIONAL JOB



- Here are some of the reasons for the accuracy, for the job performance and the long economical service life of Red Ring Shaving Cutters.
- These cutters are engineered and produced by skilled specialists who have, for the past 27 years, devoted full time to shaving cutters, exclusively. Never underestimate this vast fund of experience which is unmatched anywhere else in the field.
- All Red Ring cutter grinding and cutter inspections are carried on in temperature controlled departments, for maximum precision. Where else is this done?
- Every Red Ring Cutter is made from a controlled specification forging—proper grain flow and uniform distribution of carbides in the tooth zone.
- Every Red Ring Cutter is heat treated in Red Ring furnaces under the direct control of Red Ring metallurgists.
- Every new cutter design is given a thorough performance try out in the Red Ring Gear Laboratory before it is released.
- Red Ring cutter engineers and service specialists are always available for consultation and to help a cutter customer in an emergency.

When you buy cutters, take advantage of these extra benefits. There is no extra cost.

8263

SPUR AND HELICAL GEAR SPECIALISTS
ORIGINATORS OF ROTARY SHAVING,
GEAR HONING AND ELLIPTOID

NATIONAL BROACH & MACHINE CO.

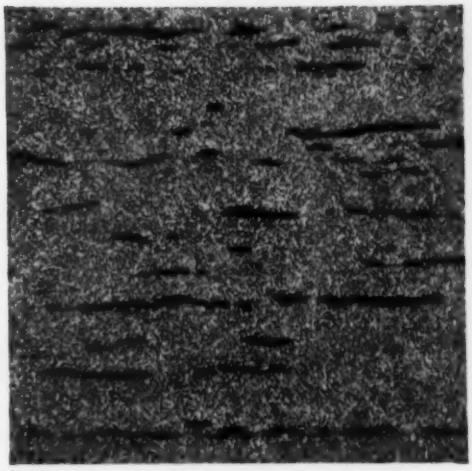
5600 ST. JEAN • DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

Why GRAPH-MO® is best steel for gages and dies ..

GREATER WEARABILITY

You get a steel that wears longer when you use Graph-Mo®. Reports from users show that Graph-Mo outwears ordinary tool steels 3 to 1! That's because of the combination of free graphite particles and diamond hard carbides in the Graph-Mo structure. You can see them in the photomicrograph at right.



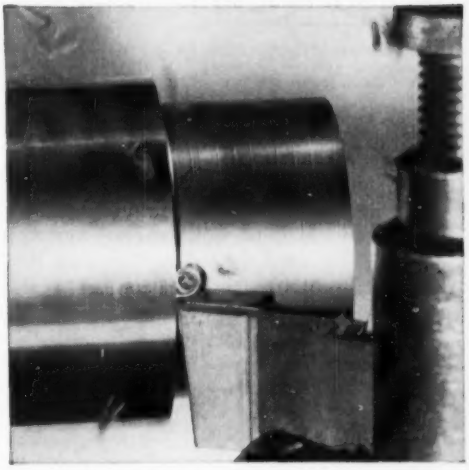
100 X

BETTER STABILITY

You get a steel that keeps gages and dies accurate longer when you use Graph-Mo. Tests prove its stability. For example, a typical master plug gage (see photo, right) made of Graph-Mo showed less than 10 millionths of an inch change after 12 years of use. Graph-Mo is the most stable gage steel ever made.

FASTER MACHINABILITY

You save machining time with Graph-Mo. It out-performs ordinary tool steels on the Constant Pressure Machinability Tests. Graph-Mo machines 30% easier. Notice short chips in the photo at right. The free graphite in its structure enables you to make tool steel parts faster. Yet with all its advantages, *Graph-Mo costs no more than other oil hardening tool steels.* For time-and-money-savings, better finished products, specify Graph-Mo. There's only one Graph-Mo, and the Timken Company makes it. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable: "TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steels and Removable Rock Bits.*



WHEN YOU BUY TIMKEN STEEL YOU GET...

1. Quality that's uniform from heat to heat, bar to bar, order to order
2. Service from the experts in specialty steels
3. Over 40 years experience in solving tough steel problems

TIMKEN® *Fine Alloy* STEEL

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

no. 7 OF A SERIES

A "SOUND" APPROACH TO RIDING COMFORT

The "tuning out" of excessive shake and vibration by Oldsmobile engineers produces a comfortable, balanced ride that adds thousands of miles to the life of an automobile.

One of the most critical areas of engineering in today's automobile is "ride". It is critical because an unsatisfactory ride means an unsatisfactory automobile. To produce an over-all balanced and smooth ride, free from harshness and fatiguing vibration, Oldsmobile engineers begin the complex task of "tuning" the car in the early stages of a new model program. Not only is ride important from the comfort standpoint, but an improperly "tuned" car can literally shake itself apart after several thousand miles.

The tuning operation is a series of intricate tests that determine a car's "shake" characteristics—where and how much the metal bends and twists. To produce beaming and torsional moments, a mechanical oscillator is attached to the frame and vibrates the car in a frequency range of 7½ to 15 cycles per second. To measure the displacement of the metal, a velocity pick-up is attached directly to the area under study. As the metal vibrates, a signal is produced by the pick-up and is fed to a vibration meter where it is integrated. The resulting signal is then transmitted to an X-Y plotter that instantly converts it into a continuous magnitude-vs.-frequency trace.

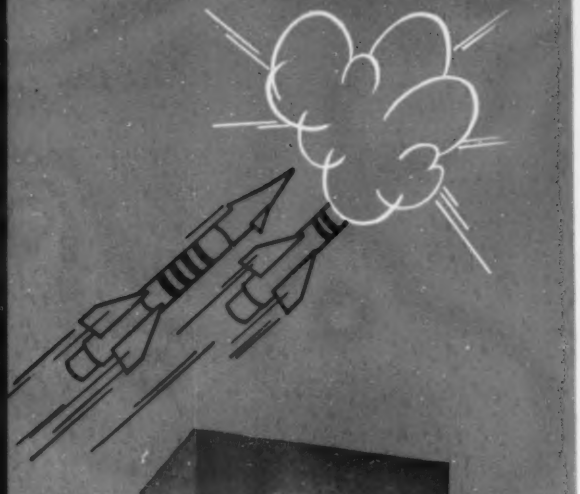
With this valuable information, refining can begin by altering the structure of the various component parts. A complex network of infinite variation must be analyzed intensively to produce the mark of quality that stamps every Oldsmobile.

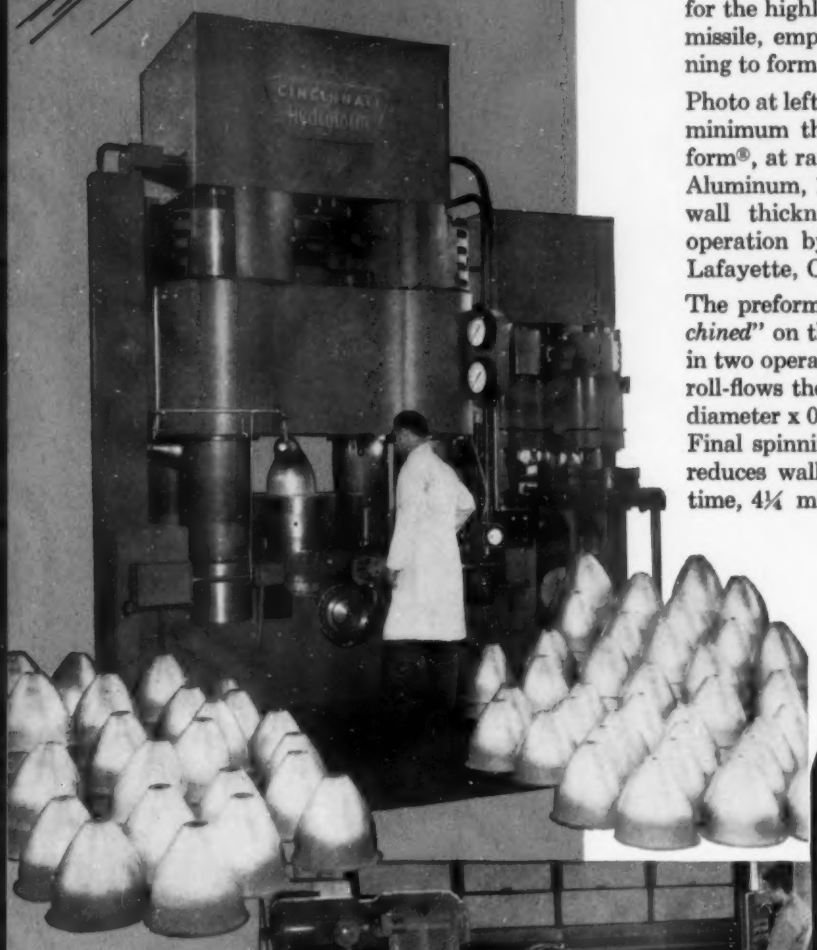
Over the years, Oldsmobile's reputation for quality manufacturing and precision engineering has grown, step by step, until today it is a car of recognized distinction—in a class by itself. Oldsmobile's durability and long service life is further attested to by its continued leadership in resale value. You owe it to yourself to first examine, then test-drive, a truly outstanding automobile—the 1959 Oldsmobile. Visit your Local Authorized Oldsmobile Quality Dealer as soon as possible.

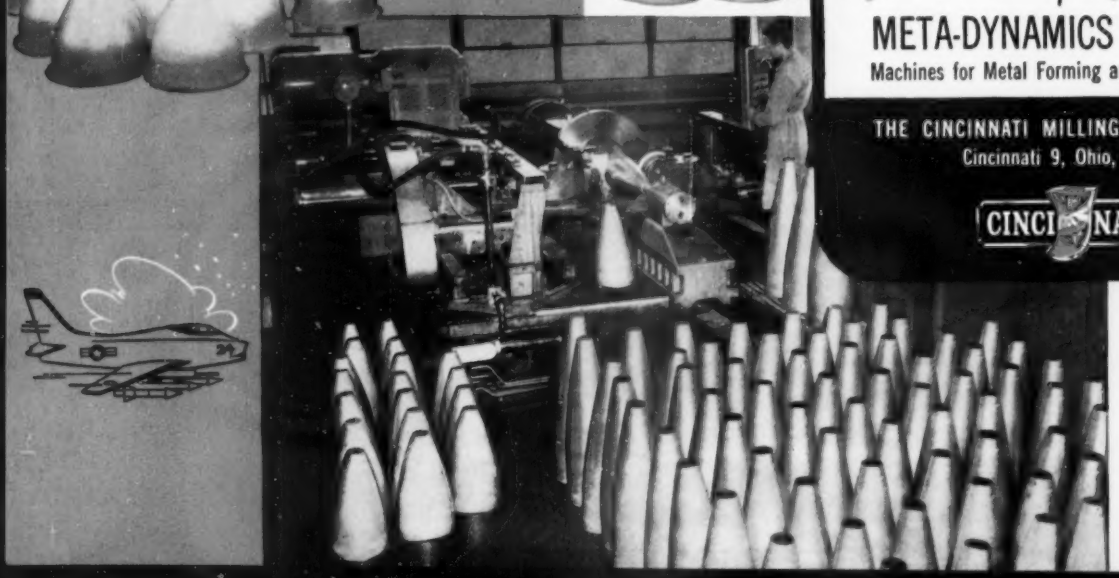
OLDSMOBILE DIVISION, GENERAL MOTORS CORPORATION

OLDSMOBILE

Pioneer in Progressive Engineering ...Famous for Quality Manufacturing







Cincinnati Hydroform · Hydrospin

make the nose sections flow for TAPCO GROUP of *Thompson Ramo Wooldridge Inc.*

Tapco Group, contractor to supply nose sections for the highly accurate, air-to-surface "Bullpup" missile, employs Hydroforming and Hydrospinning to form these parts at high production rates.

Photo at left shows preforms being produced with minimum thinout, on a Cincinnati 32″ Hydroform®, at rate of 90 per hour. Preform is of 6061 Aluminum, 14″ major diameter x 13″ deep x ⅛″ wall thickness. Preforming is a sub-contract operation by Jones Metal Products Co., West Lafayette, Ohio.

The preform is heat-treated, then "*chipless machined*" on the two-roller Cincinnati Hydrospin® in two operations (bottom photo). First spinning roll-flows the preform to 20″ length x 12″ major diameter x 0.080″ wall thickness, in 3½ minutes. Final spinning increases part length to 40″ and reduces wall thickness to 0.040″. Floor-to-floor time, 4¼ minutes.

For your missile metalworking, you'll save time and money by teaming-up with Cincinnati Hydroform and Hydrospin machines. Call in a Meta-Dynamics Division field engineer for detailed information.

Hydroform/Hydrospin

META-DYNAMICS DIVISION

Machines for Metal Forming and Heat Treating

THE CINCINNATI MILLING MACHINE CO.
Cincinnati 9, Ohio, U.S.A.

CINCINNATI

When you see uniformity, remember . . .

With Card pipe taps you get uniformity

Your production's consistent ...because Card taps are uniform

. . . And they keep your cutting costs low. Designed to meet today's high production demands, Card pipe taps assure you maximum output on every run. In addition, their long-wearing qualities mean you don't have to maintain a large investment in replacements. Your Card technical man can apply all the cost-cutting advantages of Card taps to your production. S. W. CARD DIVISION, Mansfield, Mass. Card Warehouses: Atlanta, Chicago, Detroit, Fort Worth, Los Angeles, New York, San Francisco.

The CARD Quality

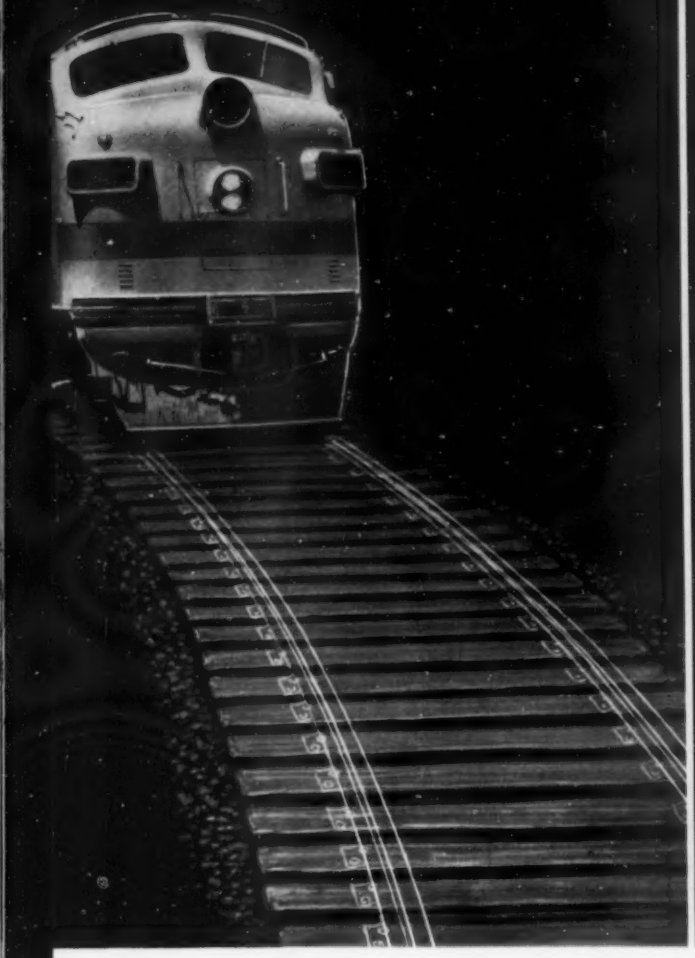
CARD

DIVISION OF UNION TWIST DRILL COMPANY

— Serving you through the best distributors from Coast to Coast

Visit the Card Booth 307 at the Triple Mill Convention in Dallas, Texas. May 13-15.

If you use inserted blade cutters as much as railroads use ties . . .



Ordering Union cutters will cut your production time and costs

The more you use cutters the more you need Union

Typical of Union's continued pioneering in the development of cutting tools, Union inserted blade cutters are designed with keyways so placed as to enable several cutters to be interlocked for faster, more efficient operation. In plants throughout the country Union technical men are showing how production time and costs can be cut with highly advanced, top-performing Union inserted blade cutters, drills, end mills, milling cutters, gear cutters, reamers, hobs and carbide tools.

Available nationally through Union Distributors and stocked in Atlanta, Chicago, Detroit, Fort Worth, Los Angeles, New York City and San Francisco.

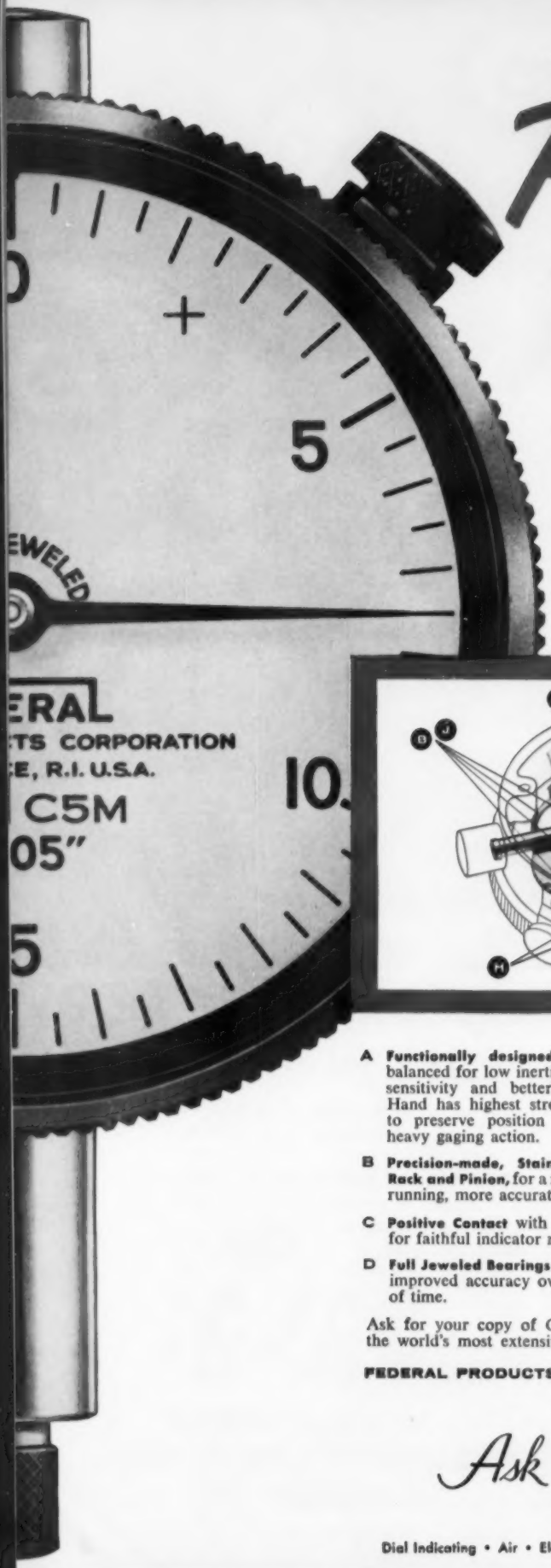
UTD

UNION

TWIST DRILL COMPANY, Athol, Massachusetts

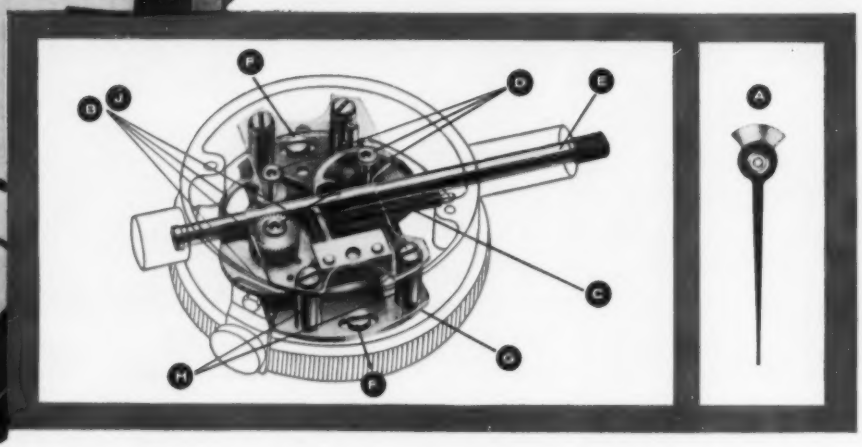
S. W. CARD DIVISION, Mansfield, Mass., BUTTERFIELD DIVISION, Derby Line, Vt.

Visit the Union booth 309 at the Triple Mill Convention in Dallas, Texas. May 13-15.



You get all these *Plus Features* only in Federal Indicators

Full Jeweled Bearings, Unit Movement, Low Inertia Indicating Hand, Tough-Hardened Gears — each of these advancements pioneered by Federal has a particular significance to you in terms of better performance. AND with all these *plus* features, Federal Dial Indicators generally sell for LESS due to their wide acceptance which has made possible the economies of quantity production. Here are the features and reasons why they are important:



A **Functionally designed Indicating Hand** balanced for low inertia, provides greater sensitivity and better repeat accuracy. Hand has highest strength-to-mass ratio to preserve position and shape under heavy gaging action.

B **Precision-made, Stainless Steel Gears, Rack and Pinion,** for a rustproof, smoother running, more accurate movement.

C **Positive Contact** with minimum pressure for faithful indicator response.

D **Full Jeweled Bearings** reduce friction, for improved accuracy over a longer period of time.

E **Precision Fit** of spindle and bearing for better repeat accuracy.

F **Accurate Movement Positioning** for optimum rack and gear alignment. Provides extremely close and positive control over a critical fit in *every* indicator.

G **Unit Construction** for easy maintenance and adjustment.

H **Rigid Assembly** of top and bottom plates for accurate gear alignment essential to minimum wear.

J **Tough-Hardened Gears** available optionally on most models for greatly increased life, reduced friction and improved sensitivity.

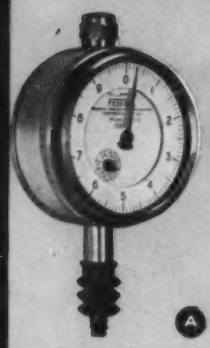
Ask for your copy of Catalog 58. It describes the full line of Federal Dial Indicators — the world's most extensive line.

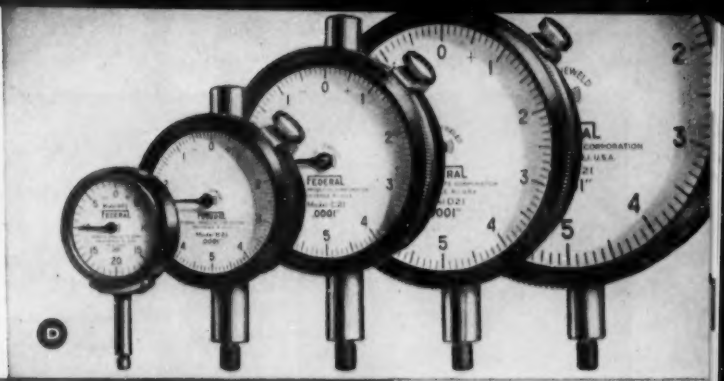
FEDERAL PRODUCTS CORPORATION • 9194 Eddy Street • Providence 1, R. I.

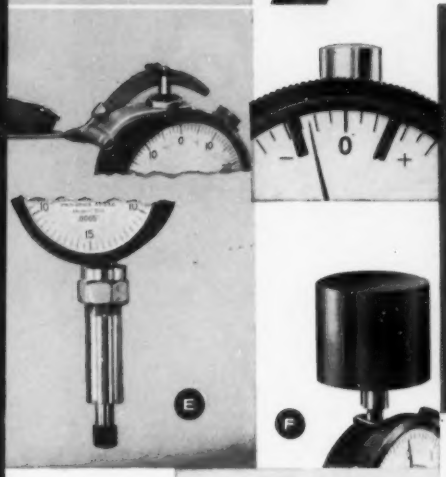
Ask **FEDERAL** *First*

for recommendations in modern gages . . .

Dial Indicating • Air • Electric, or Electronic — for inspecting, measuring, sorting, or automation Gaging







whatever you need in DIAL INDICATORS

A **Wet-proof Indicator.** Protected from coolant, oil, oil fog, and other liquid contaminants. Seven models, four magnifications.

B **Series L Testmaster.** Long range (.032" and .060"), high magnification. Large or regular size dials, two styles. .0001" or .0005" grads., eight models.

C **Series M Testmaster.** The Universal Test Indicator. Two styles. .001" or .0001" grads., eight models, plus non-magnetic.

D **Regular Dial Indicators.** Five sizes including A.G.D. groups 1 through 4. Over eighty different basic models plus thousands of variations.

E **Auxiliary Plunger** (new precision transfer unit) and new **Cam Type Lifting Lever** extend usefulness and preserve accurate reading of Federal Dial Indicators.

F **New style Tolerance Hands** set easily, lock securely. **Weights** for measurement of compressible materials. Made to your or A. S. T. M. specs.

G **Perpendicular Indicators.** Two sizes, seven models. Crown or spiral gear movement.

H **Long Range Indicators.** Wide variety of models up to 3" range, .001" to .0001" grads.

I **Hardened Gear Movement** greatly increases indicator life, improves performance. Available on all A.G.D. models . . . most other models.

J **Super-Sensitive Indicators.** Ultimate in indicator precision. Five models, .0001" or .00005" grads.

K **Dials** for any magnification. Also balanced, continuous, clockwise, counter-clockwise — with rev. counters, special markings, etc.

L **Attachments.** Right Angle or Hole . . . precision transfer units for checking "inaccessible" places.

M **Contact Points.** Many shapes, dozens of sizes. Polished tips, hardened steel, chrome, T.C., etc.

N **Backs.** Regular, offset, post, screw, adjustable, and flat. Special backs to order.

Ask for Catalog 58 describing the complete line of Federal Dial Indicators.

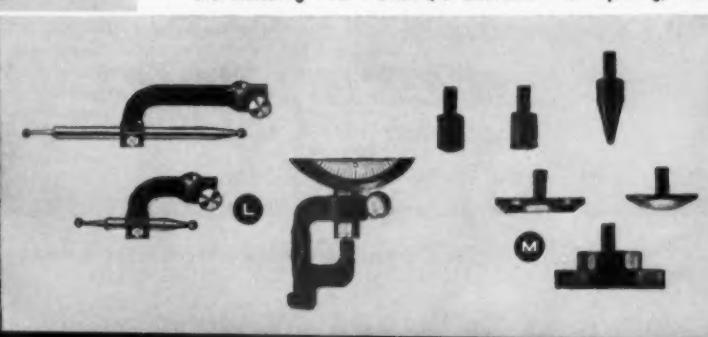
FEDERAL PRODUCTS CORPORATION

9194 Eddy Street • Providence 1, R. I.

Ask **FEDERAL** *First*

for recommendations in modern gages . . .

Dial Indicating • Air • Electric, or Electronic — for inspecting, measuring, sorting, or automation Gaging



Bodine

CASE HISTORY No. 49

showing what ONE versatile Bodine is doing for MANNING, MAXWELL & MOORE, Inc.

PARTS:
One is brass, the other tough AISI 347 Stainless Steel.

OPERATIONS:
Drill, chamfer and tap (#8-32) two holes 5/16" deep.

PRODUCTION:
Brass, 800/50 min. hour, Stainless, 175/50 min. hour.

PARTS:
Brass.

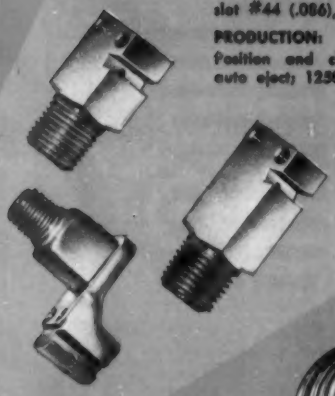
OPERATIONS:
Drill and countersink two holes, .173" dia. with .350", 82° countersink. Also drill and tap (#2-56) two holes.

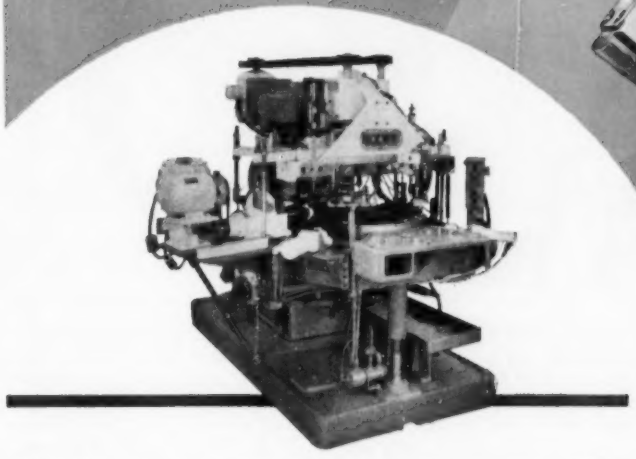
PRODUCTION:
1500/50 min. hour.

PARTS:
Forged brass gauge-sockets.

OPERATIONS:
An unusual feature is two-step drilling of two holes . . . first 1/2-way through, using #37 (.104") half-round drills with bushings; then drill through and chamfer in one operation, using combination half-round drills. By this method tolerances on hole centers are held to ± .001" on the entry and ± .003" on exit side after drilling through 9/16" of stock. Tap some two holes #6-32 9/32" deep. Mill slot .135" (± .002") wide x .156" deep with horizontal milling spindle and 4" saw-type cutter. Drill hole from bottom of milled slot #44 (.086), 5/16" deep.

PRODUCTION:
Position and clamp; auto unclamp and auto eject; 1250 pieces per 50 min. hour.





PART:
Stainless Steel (AISI 347).

OPERATIONS:
Drill, chamfer and tap (#2-56) two holes 3/16" deep.

PRODUCTION:
150/50 min. hour.

All these parts and operations on ONE machine with only TWO dial changes!

Here is a good example of Bodine versatility . . . and especially of the ability of a single Bodine Basic Machine to handle exacting jobs of widely differing shapes, sizes, materials and operations . . . with changeover reckoned in minutes rather than hours.

All of these parts are processed with only two dial changes. Spindles, other accessory equipment, and tooling are also basically standardized Bodine units. Retooling for possible future part and operation changes will be relatively simple and inexpensive . . . an important Bodine feature.

Isn't this the kind of time-saving, cost-cutting production engineering you, too, are looking for? If so, do not hesitate to ask us for production analysis of your next job. Write Dept. TE-4.

THE **Bodine** CORPORATION

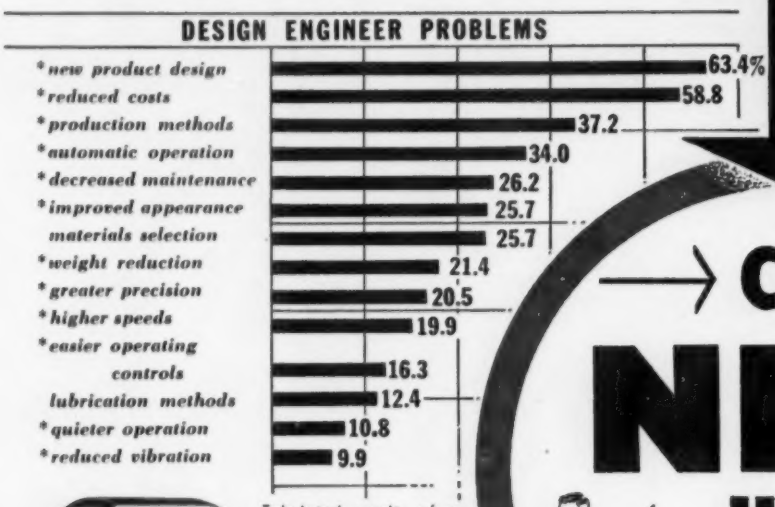
BRIDGEPORT 5, CONNECTICUT

AUTOMATIC DIAL TYPE DRILLING, MILLING, TAPPING, AND SCREW INSERTING MACHINES

18D59

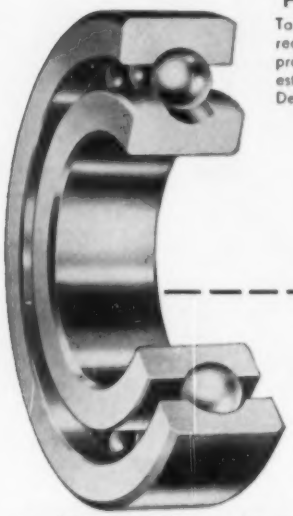
BEARING SELECTION IS AN IMPORTANT FACTOR...

in 12 Out of 14 Design Engineering Problems...



Tabulated results of a recent survey showing the problems receiving greatest attention from Product Designers.

→ Can NICE Help YOU?



As illustrated above, the new UNIBAL Ball Bearing features solid inner and outer raceways, with deep, unbroken ball grooves, PLUS a full complement of balls.

Yes, whether it be new product design, reduced costs, quieter operation or any of 12 of the 14 principal design engineering problems, the selection of bearings is a major consideration. And NICE BALL BEARING COMPANY produces complete lines of precision, semi-precision and unground standard and special bearings. Hence, NICE field and factory engineers offer the advantage of a diversified product and experience... and are well qualified to recommend or design the economically and functionally correct bearing for your particular application.

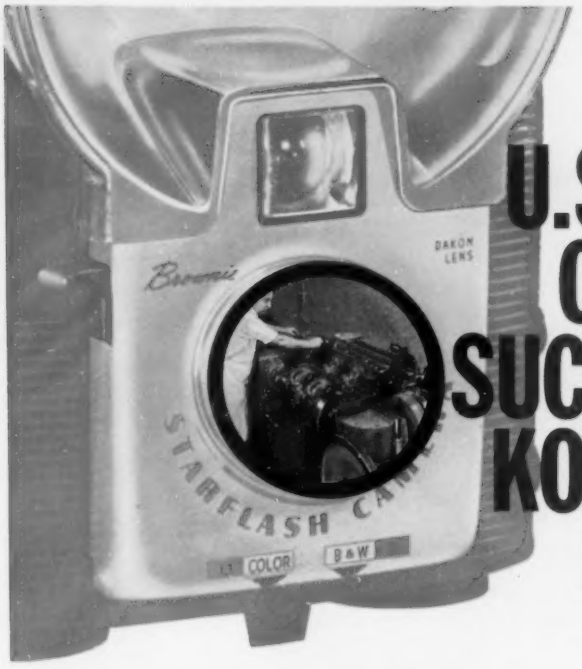
The new UNIBAL®, a NICE ball bearing of revolutionary design†, has opened up an entirely new area of savings and design improvement possibilities.

Have you investigated the design and cost saving opportunities offered by the NICE Line?

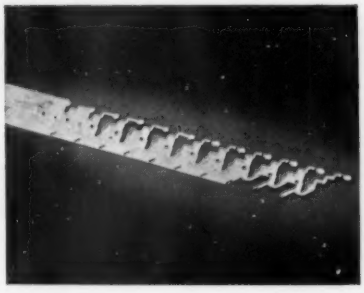
†Patent Applied For

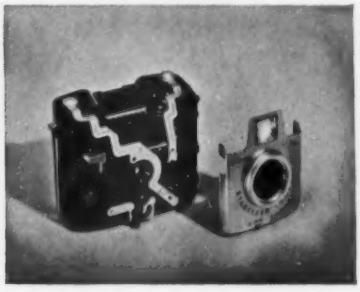
NICE®

NICE BALL BEARING COMPANY
NICETOWN · PHILADELPHIA · PENNSYLVANIA
DIVISION OF CHANNING CORPORATION



U.S. MULTI-SLIDE® CONTRIBUTES TO SUCCESS OF KODAK BROWNIE STARFLASH!





Manufacture of a reliable, practical camera, with a built-in flash, that will sell at a popular price calls for considerable engineering skill and technical know-how. It calls for good design and sturdy construction. It demands consistently accurate production — unwavering accuracy at high speeds. ● Eastman Kodak Company has been using U.S. Multi-Slide Machines for many years and has found them satisfactory in high volume production of irregularly shaped parts. Parts are manufactured without intermediate handling or secondary operations that would have been required by conventional methods. Presently, Eastman Kodak Company's Apparatus & Optical Division uses U.S. Multi-Slides for the production of no less than six parts for Brownie Star Cameras; the Starflash, Starflex and Starlet. ● A Model #33 U.S. Multi-Slide is used to produce battery connectors for the Brownie Starflash. The machine is arranged with multiple rams and tooling with three separate die stages — producing a completed part at each cycle. ● Because of their versatility, the U.S. Multi-Slides could be readily adapted by Eastman Kodak's A. & O. Division to manufacture other flat stock stampings, wire parts, or the simultaneous feeding and processing of more than one strip to complete an assembly. Prefabricated parts could be hoppered, positioned and assembled to the stamping being made in the machine. ● **Write today to find out how U.S. Multi-Slides can produce your stamped components better and more efficiently . . . ask for Bulletin #15T or send in samples or drawings of the part you want produced.**

ILLUSTRATED ABOVE: The popular Kodak Brownie Starflash Camera . . . **LEFT TO RIGHT:** Successive stages in the production of Brownie Starflash Battery Connectors as stamped by U. S. Model #33 Multi-Slide . . . Brownie Starflash Camera disassembled (built-in flash removed) to show location of battery connector produced on a #33 U. S. Multi-Slide, part of flash synchronization circuitry . . . U. S. Multi-Slide Model #33 in use at Eastman Kodak Company's Apparatus & Optical Division in Rochester, New York . . . Machine is turning out battery connectors for the Brownie Starflash Camera.

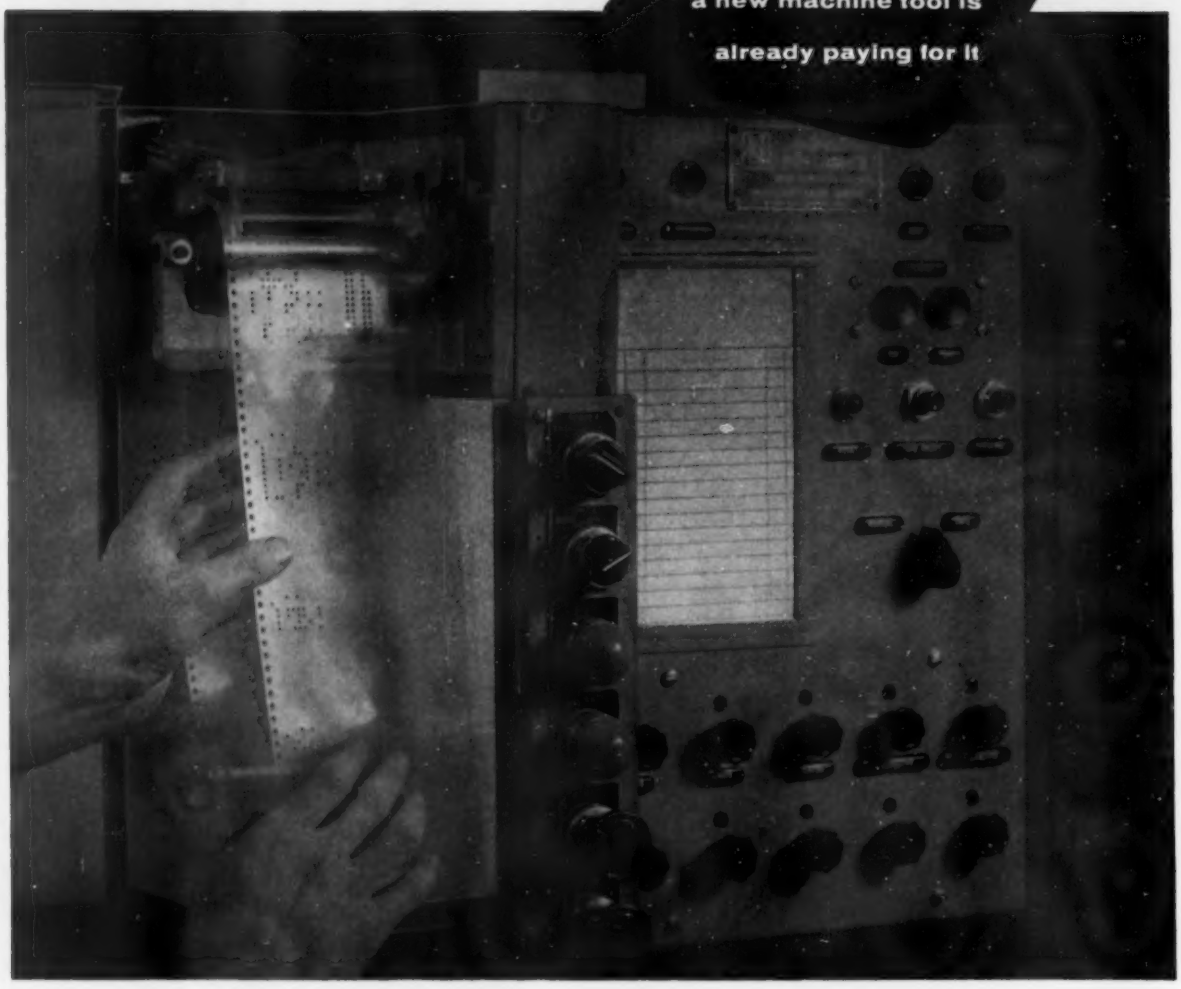
U. S. TOOL COMPANY, INC. AMPERE (East Orange) NEW JERSEY

U. S. Multi-Slides® • U. S. Multi-Millers® • U. S. Automatic Press Room Equipment • U. S. Die Sets and Accessories

US MULTI-SLIDE

JONES & LAMSON "AUTOMATION"

the man who needs a new machine tool is already paying for it



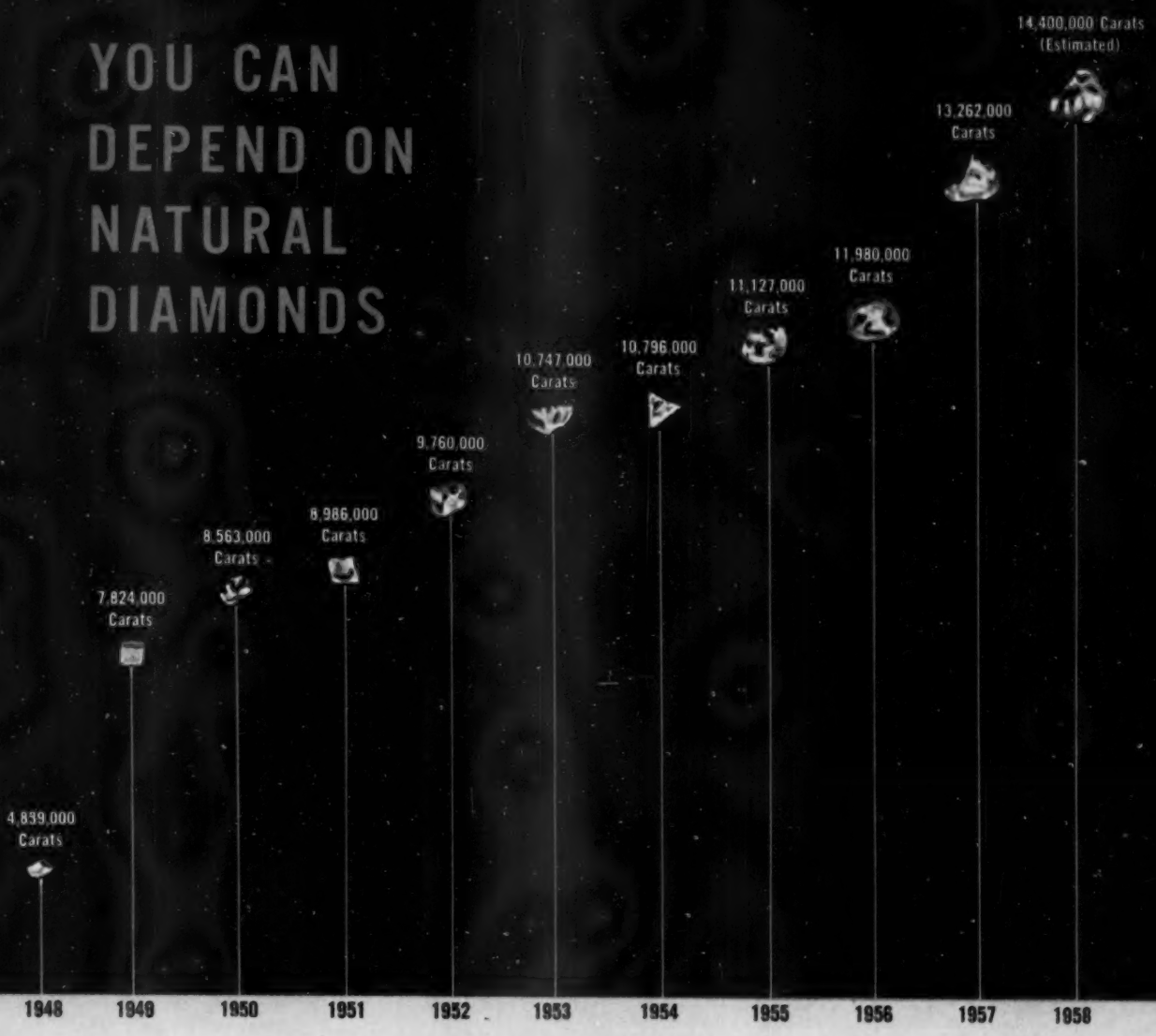
Numerical Control . . . what's it worth?

What *about* numerical control: is it all it's cracked up to be? The answer, in a word, is "yes". Here's why. With numerical control, the *big* factor is *flexibility*. Tape or numerical programming can be employed economically for medium or small lot production, even down to *single pieces*. Accuracy is also increased. For instance, Jones and Lamson tape controlled positioning units hold tolerances of ±.001 on applications for punching, drilling, boring or similar operations where point-to-point positioning is mandatory. Machine set-up and change-over become primarily an office procedure. Numerical control of machining operations eliminates the need for cams, templates, even prototype parts and special fixtures. It results in greater machine utilization, and speeds actual machining. Lead time is reduced, and because human error is largely eliminated, accuracy is improved.

Any way you look at it, numerical control has come of age. It's being used more and more, simply because it produces better, at lower costs. For detailed information, write Jones & Lamson Machine Company, Dept. 710, 518 Clinton Street, Springfield, Vermont.

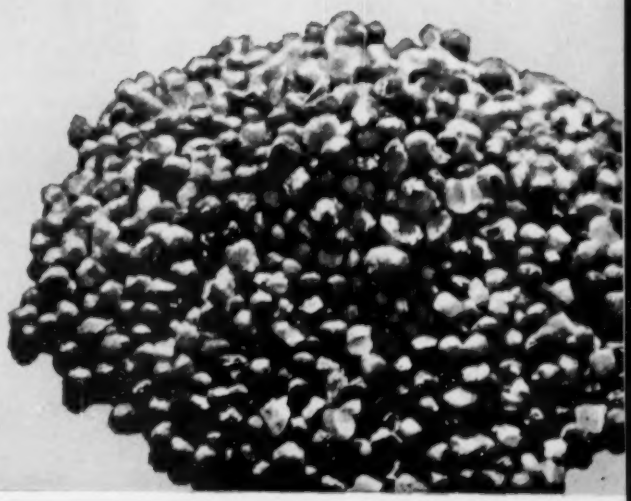
Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

YOU CAN DEPEND ON NATURAL DIAMONDS



Boart production rises 197% in 10 years

Since 1948 production of crushing boart has risen 197 per cent. This means that there are ample supplies of natural diamond mesh for all the needs of American industry.



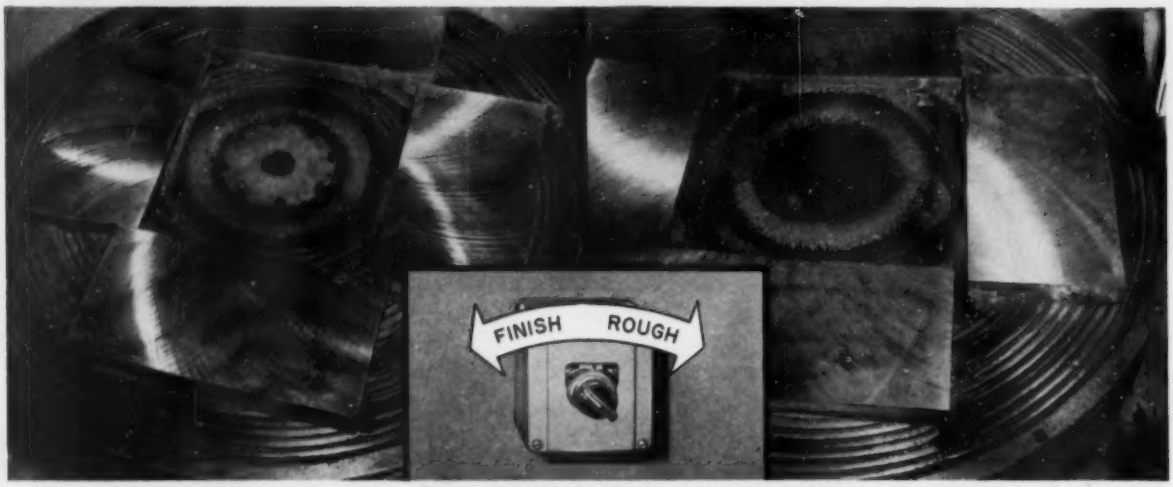
INDUSTRIAL DISTRIBUTORS (SALES), LTD.

MATTISON
HIGH-POWERED PRECISION
GRINDING METHODS

New grinding method

speeds production, increases accuracy...or both

Mattison's Quick®-Tilt spindle gives you two operations for less than the price of one



Characteristic cross-hatching shows how accurately the power-tilting device returns the wheel to the flat position.

Operator just turns the selector switch to tilt the spindle back to vertical for finish grinding and sparking out.

Harder wheels and higher downfeeds were used in roughing these large, mild steel plates on the Mattison "No. 24."

Mattison's new "Quick-Tilt" spindle changes the entire economics of surface grinding. Machines equipped with up to 60 hp spindle motors are designed to cut metal, not "scratch it." Higher downfeeds can be used to increase production by as much as 50%.

Want to replace an obsolete vertical spindle surface grinder with a machine that improves all aspects of metal removal? Here is a machine that will increase your production without compromising flatness. In fact, it probably will improve both.

Perhaps your management wants more than an outsider's production estimate before approving a replacement proposal. Mattison will give you conclusive evidence of performance *on your job*, at no obligation other than the cost of shipping sample pieceparts to Rockford.

We will set up your parts on a grinder equipped with the most profit-significant new feature in 60 years—our automatic, power-actuated, Quick-Tilt spindle. You can see first hand, on your own pieceparts in the Mattison Methods Laboratory, how surface grinding can be changed from a "metal-scratching" operation to a profitable metal-cutting operation.

If you are a grinding man, you know that it takes pressure backed up by rigid machine construction to hog off metal with an abrasive wheel . . . and our No. 24's and 36's have more "beef" in the right places than any similar machines.

To this, we have added the Quick-Tilt spindle which really consolidates all of the advantages of power and rigidity. With the flick of a switch, you can tilt the spindle .008 to .010 in. above and below center, reducing the contact area between the wheel and the work. This permits you to start your job by taking a harder cut, grinding freely without danger of heat-checking—tearing out dull grits automatically to reduce the number of wheel dressings. This means higher downfeeds—faster production.

As your parts approach size, the automatic sizer shuts off the machine and the operator turns the selector switch to "flat." This tilts the spindle back to the true vertical position for grinding out all concavity. In less time than it takes to do a roughing operation on a conventional grinder, you get pieceparts which are dead flat on a 36" or 48" diameter.

Mattison "No. 24" has a rigid one-piece column which starts at the floor. Only the wheel head tilts.

60 hp on the No. 24

The Mattison "No. 24," with 18" capacity under the wheel (24" optional), is available with 42" table plus these important new features:

1. Continuous downfeed
2. Automatic cycling
3. Air gage measuring
4. Separate coolant tank
5. Fully protected ways

Here is a machine that reduces nonproductive time for wheel changing and dressing . . . virtually eliminates downtime for cleaning . . . and increases both productivity and accuracy.

Tell your Mattison dealer you want sample pieceparts ground in our Methods Laboratory on a Quick-Tilt machine. He will make all the arrangements for a convincing test which costs you nothing but the freight. Or, phone the factory direct.

MATTISON MACHINE WORKS
Rockford, Illinois WOodland 2-5521

MATTISON MACHINE WORKS
HIGH-POWERED PRECISION SURFACE GRINDERS

NEW PRODUCT ISSUE

Stuart

Productive Lubrication

FOR PROFIT-MINDED PRODUCTION MEN

VOL. 1, NO. 3

MARCH-APRIL 1959

new

Stuart's HI-D* trims hidden costs on grinders at Torrington Bantam Bearing Division

Proves high-detergency grinding fluid can be a flexible cost-reduction tool

This precision roller bearing manufacturer has found out what it takes in a grinding fluid to uncover hidden savings like these:

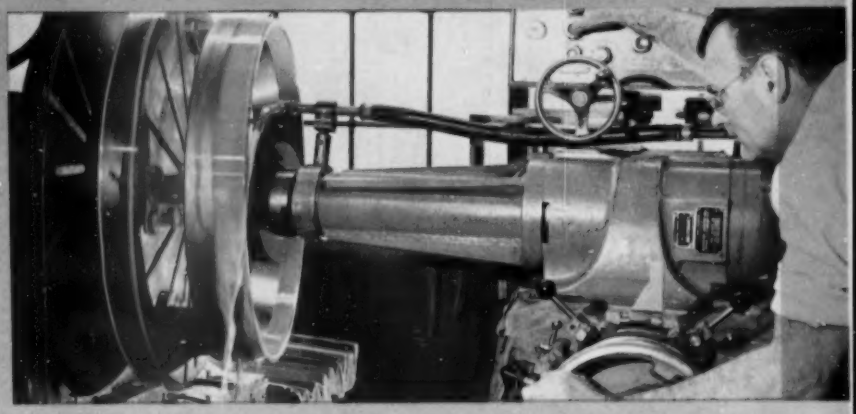
1. Less downtime for wheel dressing and cleaning machines.

2. Longer wheel and diamond life.

The people at The Torrington Company, Bantam Bearing Division, South Bend, Indiana, diligently tested Stuart's new HI-D in a quest for mastery of chips and heat that determine wheel performance and work quality. They put it through its paces against six tough candidates to find the one best fluid for the average condition on 87 grinders—one that would perform most efficiently in their Hoffman flotation-type filter.

We were delighted, but not surprised, when Stuart's HI-D took top honors for both performance and economy. The reason is not too baffling. A new petrochemical detergent in Stuart's HI-D does a yeoman's job of keeping grinding wheels free-cutting. And in our opinion, the use of good "chemical soaps" for washing the fine hair-like chips from between the grits of a grinding wheel is a factor that deserves plenty of appraisal nowadays.

Torrington's efforts paid off. Today, wheels require dressing only ½ as often as they used to. Think of the savings from longer wheel and diamond life. But, even deeper benefits result from the elimination and control of downtime for dressing wheels. Wheel change time has been reduced, too, because now Torrington can do both roughing and finishing with a fine grit wheel. Formerly, two wheels had to be used.



On machines like this universal gap grinder, wheels can remove .030" before dressing; whereas, previous coolants made dressing necessary at .010".

Solves chip removal problem

The hoe-and-wheelbarrow method of cleaning swarf from machine tools was abandoned by Torrington years ago. They float their chips and separate them in the central system. Hence, the grinding fluid must foam under proper agitation in the Hoffman flotation filter so chips can be winnowed out in a layer of rich lather. Elimination of chip carry-through is particularly important when grinding fine finishes on 52100, 8660, 4620, and E3310 Krupp, plus different grades of stainless, bronze, and aluminum. Stuart's HI-D proved to be 95% efficient in this respect. Only clean grinding fluid is returned to the machines and line obstructions due to chip precipitation have been avoided.

Reduces grinding fluid cost

Torrington reduced its coolant cost, too. Stuart's HI-D saved ⅓ the cost of the grinding fluid it replaced. The reason is, it stays on the beam at mixtures as lean as 60:1. The less expensive compounds lost their efficiency at anything greater than 40:1.

A three-month try-out on equipment like this proved Stuart's HI-D to be the best of seven grinding compounds tested at Torrington.

The cooling qualities of Stuart's HI-D at 60:1 produced another saving worth mentioning. Bryant "Centalign" grinders, which turn out small and very accurate bearings in the amazing time of 10 to 11 seconds, are hooked into the central system. With the former 16:1 coolant in the machines, the bearings came out hot. But now, with clean abrasive capable of cutting the metal instead of rubbing it, the bearings actually come out cool.

* Formerly: Dasco 102-M-18

MORE PL FACTS ▶

Productive Lubrication

new

Stuart's HI-D* checks rust, reduces costs at La Salle Steel

Stuart's new high-detergency, wide-purpose chemical compound—HI-D—proved to be just what the people at La Salle Steel Company wanted: a cutting fluid that works equally well for grinding or turning, and is capable of inhibiting rust at economically lean mixtures.

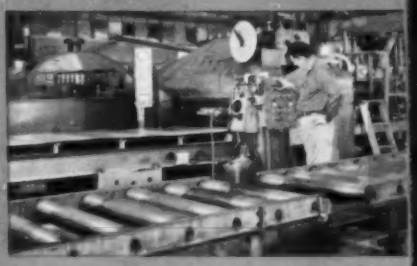
During its preliminary evaluation, Stuart's HI-D was put on two Medart turners. We're happy to report (having more than a passing interest in this product) that it made a versatile showing and was immediately put to work on 9 machines in the grinding and turning department. Jobs ranged from roughing cuts of 1/16" to 1/4" on the turners to lighter cuts for accuracy and fine finish on the grinding machines. Which brings up one of the ticklish problems at La Salle . . . in-plant protection for highly finished steel bar stock.

In testing other lubricants, La Salle found bars rusted too readily at dilutions of 30:1. But Stuart's HI-D worked efficiently at a 50:1 dilution while it held its high detergency and lubricity potency for efficient turning and grinding. La Salle maintained quality and at the same time reduced cutting fluid costs plenty (45%).

Stuart's HI-D can be used at 50:1 on machines like this centerless grinder as compared with 15:1 for the previous compound.

If you're looking for a cutting compound that combines high detergency, rust prevention, wide job range, high cooling capacity, and excellent lubricity, it will pay you to call in a Stuart representative. Our real objective is even more direct — buy a drum of Stuart's HI-D and test it on your problem jobs.

* Formerly: Dasco 102-M-18



Flexible E.P. Rolling Oil boosts bearing life 50% on Sendzimir cold sheet mill

By using Stuart's Rol-Kleen 6 on their Sendzimir mill, Atlas Steels Limited, Welland, Ontario, stopped bearing failure due to lubricant breakdown — bearing life zoomed 50%.

Pumped from a 1700-gallon pit-installed tank to both bearings and work rolls, Stuart's Rol-Kleen 6 proved to be a real bear in the 21 bearings of the Sendzimir mill. Galling and spawling were eliminated. And yet it has the extra lubricity Atlas needed for rolling top-notch surface finishes on stainless and aircraft super-alloy sheets.

In the three years Atlas has used Stuart's dual-purpose Rol-Kleen 6, no bearing replacements have been traced to a lubricant failure. Reduction in maintenance has been a big factor in helping to control production at a profitable level.

Atlas turns out 2B and 2D finishes as well as light gage No. 4, using an E.P. type lubricant, Stuart's Rol-Kleen 6, for rolling as well as for bearing lubrication.

METALWORKING LUBRICANTS

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Tool Steel Topics

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Lehigh H makes deep draw... passes test with flying colors

It takes a deep draw to form these cone-shaped lamp shades from .025 in. steel sheet at Keystone Lamp Manufacturing Co., Slatington, Pa. The forming die frequently gave trouble, causing production to bog down.

The lamp maker contacted Luria Steel Supply Co., a distributor of Bethlehem tool steel. "We know the job is difficult," they said, "but perhaps you can tell us about a tool steel that will withstand such a deep draw."

The Luria representative had seen such problems before. "I'd recommend Lehigh H," he told them. "I've seen it handle plenty of tough applications. It has all the stamina you need for this job, and then some."

The Lehigh H die, hardened to Rockwell C60, performed just as he said it would. It had high surface hardness to prevent pickup and galling. Because of its high wear-resistance, it averaged 200,000 shades, a substantial increase. Only .010 in. had to be removed when redressing was necessary.

Lehigh H (AISI D-2) is our standard high-carbon, high-chromium grade of air-hardening tool steel. It is a deep-hardening grade with high compressive strength. It has high wear-resistance, plenty of toughness, and minimum size change during heat-treatment — the characteristics you need most for maximum production.

TYPICAL ANALYSIS

Carbon 1.55 Chromium 11.50 Molybdenum 0.80
Manganese 0.40 Vanadium 0.90

The best way to appreciate the advantages of Lehigh H is to put it to work. A trial run in your shop can be arranged by your local Bethlehem tool steel distributor.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

You Can Remedy Fatigue-Failures

Chisels and other tools which are subjected to repeated stresses often fail suddenly. Because these tools are made from shock-resisting steel, the sudden failures can appear mysterious. However, close inspection of the failed parts often reveals that the failures were not sudden at all. They occurred because a crack progressed part way through the section, followed by sudden fracture of the remaining section.

Fatigue-fractures have a characteristic, smooth-rubbed surface where the initial crack opened up, plus an inner crystalline zone revealed by the final sudden break. Often the smooth-rubbed surface shows parallel "oyster-shell" markings, and sometimes, evidence of rusting.

As a rule, fatigue-failures begin at a stress-concentration point, such as a notch, a poor fillet, tool mark, accidental nick, or deep stamping. The proper cure is to correct such design or mechanical faults promptly.

USE UPSET-FORGED DISCS FOR ALUMINUM EXTRUSIONS TOOLING

Bethlehem produces a full line of upset-forged discs for the manufacture of dies for aluminum extrusions. The discs are forged by expert hammer crews. They are finished in ring dies to insure good section. You can choose from two grades of tool steel—Cromo-WV, chrome-moly-tungsten-vanadium (H-12), and Cromo-High V, chrome-moly-high vanadium (H-13). Each grade has good resistance to erosion and heat-checking.

New

SKINNER DUCTILE IRON TROUGH VISES

are more rigid, stronger . . . and tougher!

● Thanks to the use of a unique new metal, ductile iron, these new Skinner milling machine trough vises have *extra* strength to resist cracking, *extra* toughness to take abuse, *extra* hardness to withstand heavy blows, and *extra* rigidity for extreme accuracy and holding power. They vibrate less, too . . . reducing scrap and tool breakage. You can expect these new Skinner D-I-T vises to hold up longer in service than any other construction and to require a minimum of maintenance.

The holding capacity of these vises is equal to the full width of the jaws. And the precision-machined jaws are rugged enough to hold work under the severest conditions. A flat, smooth body keeps chips from getting under the movable jaw. And a large trough guides the coolant to return — keeps it from slopping over. A square lock construction provides additional rigidity.

Jaw widths: 4″, 5″, 6″, 7″, 8″. Optional swivel base for setting vise at any angle through 360° in a horizontal plane.

Skinner Vises and Chucks are available nationally from leading Industrial Distributors, Machine Tool Builders and Dealers. For complete information, contact a Skinner Representative or write us at Dept. 184.

SKINNER CHUCK®

SKINNER VISES

THE CREST OF QUALITY THE SKINNER CHUCK COMPANY • NEW BRITAIN, CONNECTICUT

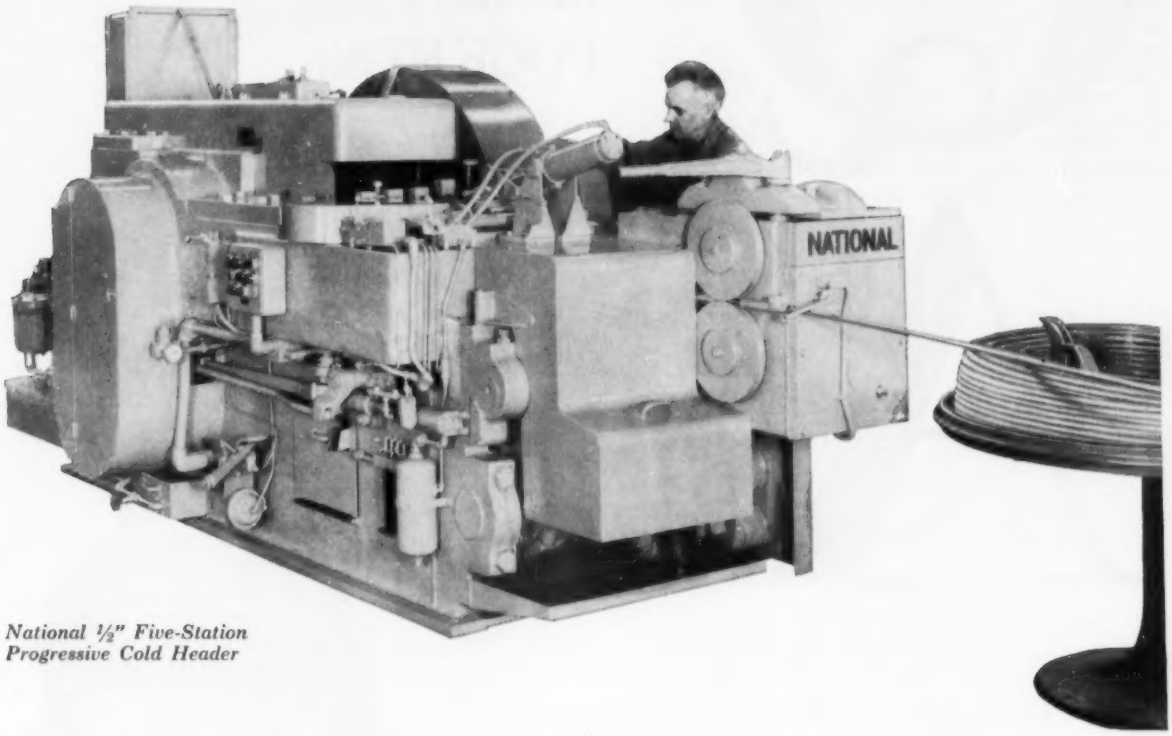
Top row, left to right: piston pin, wheel nut, ball stud, pump shaft, faucet stem.
Middle row: spark plug body, eye bolt, shuttle tip, ball socket, universal joint bearing cup, splined square-head shaft.
Bottom row: tube nut, tappet plunger, hollow rivet, blind rivet, distributor cap insert, commutator bar.

These are typical parts you can make to advantage, not by wasteful cutting, but by *cold heading* — flowing metal into accurate shapes. All of the above jobs, with one exception, were made complete from coiled wire to finished part, without intermediate annealing and coating, *in one compact machine!*

Why are formerly difficult-to-head jobs like these not only possible now, but commercial? The answer is teamwork, on many fronts. For example:

(1) More versatile metals are now available in coiled wire. (2) Die materials and lubricants are still better. (3) We are getting important (to us) but usually insignificant concessions from cold-heading-minded parts designers. (4) National Cold Headers, multiple-die Progressive Headers, Cold Formers

The modern way to make Metal Parts faster, stronger, to amazingly close dimensions!



National ½" Five-Station Progressive Cold Header

and Boltmakers, backed by our fast-growing engineering experience, are now specially equipped to produce reliably the formerly difficult jobs like these shown here.

Are your production problems like these? Perhaps cold heading could pay off for you in a remarkably short time. Let's find out.

Here is our service to metalworking, and you are under no obligation to buy. Send us samples or prints of your jobs. Better yet, bring them to Tiffin where more of our experienced people can participate in *your* problem.

We shall be happy to work with you in developing that better method.

Founded 1874—DESIGNERS and BUILDERS of MODERN FORGING MACHINES • MAXIPRESSES • REDUCEROLLS • COLD HEADERS BOLTMAKERS • NUT FORMERS • TAPPERS • NAILMAKERS CO-PIONEERS WITH INDUSTRY OF ADVANCED METALWORKING PRODUCTION METHODS

NATIONAL MACHINERY CO.

TIFFIN, OHIO, U. S. A.

HARTFORD **DETROIT** **CHICAGO**

Q.

Are you drilling holes in your MONEY POCKET?

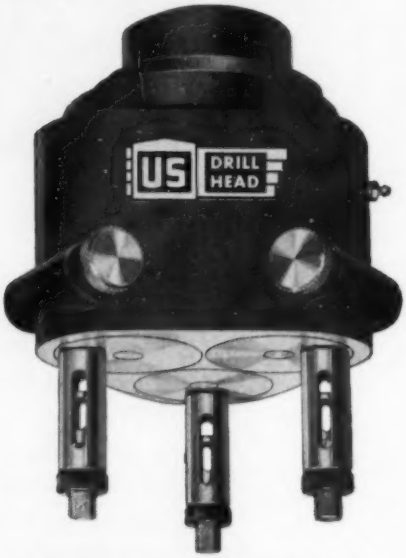
A.

NOT when you use *U. S. DRILL HEADS!*

That's because Adjustable U. S. Drill Heads are designed and built for profit-making performance!

Positive all-gear drive . . . Shaved gears for smooth, quiet operation . . . High factor of safety in design for greater reliability . . . Anti-friction bearing mounting of shafts and spindles for permanent alignment . . . Double Duty tools—when your drilling machine has a reversing spindle, you can drill and tap the same hole pattern with one head.

Write for Catalog AD-57. Or, send specifications of your requirements. No obligation, of course.



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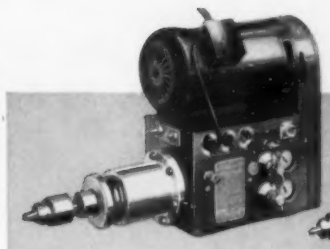

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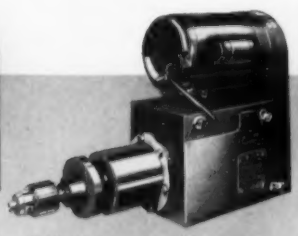
Fully automatic with all controls built-in for long or short runs and frequent changeovers. From $613.*



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YOUR KEY to all-purpose machining—anywhere. It permits fast, easy mounting in any position, angle, or direction in single or multiple unit set-ups. Changeovers to other operations, when required, are made quickly, speedily. Return to original set-up is equally fast.

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and these building-block accessories . . .

. . . let you use any Dumore Drill Unit where you can make the most of its versatile capacity. On drill press columns for single or multiple spindle applications; or added to single or multi-purpose production set-ups, transfer machines and other automatic systems. By combining several units, many machining operations on parts can be achieved in one set-up.

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Includes head, mounting bracket, circular or rectangular table, column and base.

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For opposed unit, horizontal mounting. Units can be adjusted along cross arm in relation to central fixture.

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Provide mounting space and circular adjustment for several Units to simultaneously machine small parts in central fixture.

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Fits Units 24, 26 and 28. For simultaneous drilling or tapping of 2, 3 or 4 holes. Spindle center distances quickly changeable.

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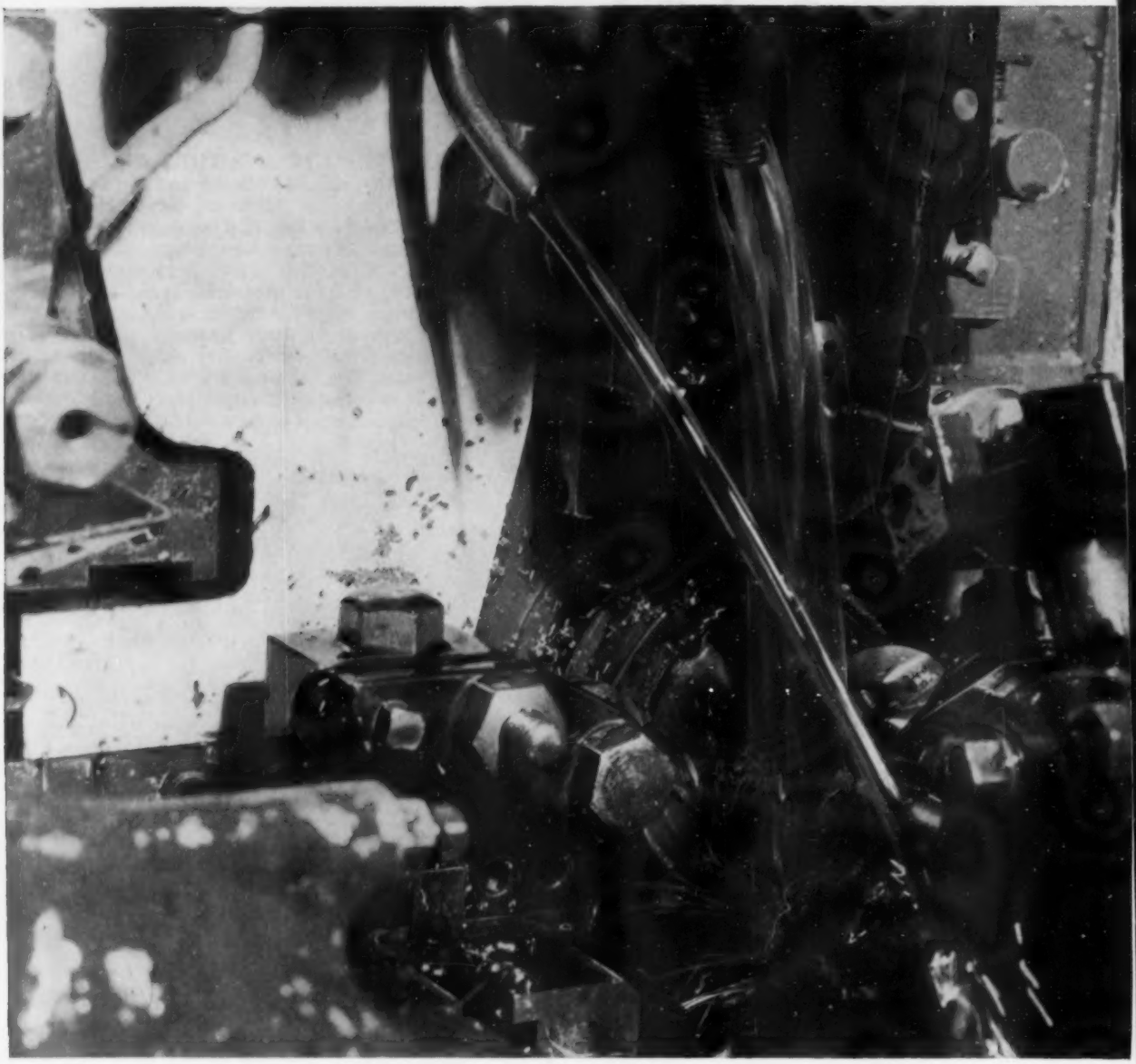


Holds tolerances of .0005 on stainless steel . . . cuts time

GULF MAKES THINGS

"Quite often we are required to hold to tolerances of .0005 on stainless steel in both automatic and hand screw machines," reports Wallace J. Perzanoski, Foreman of the Screw Machine Department, Cramer Controls Corporation, Centerbrook, Connecticut.

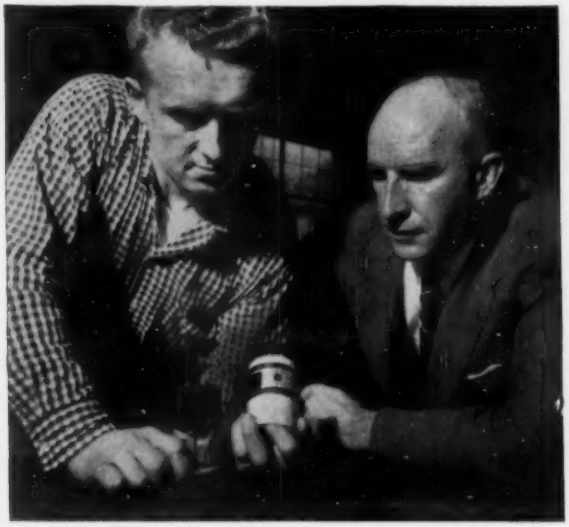
"The two cutting oils we now use . . . Gulfcut 41C for stainless steel and bronze, and Gulfcut 31A for regular brass and cold rolled steel . . . help us hold to critical tolerances. Moreover, we have shortened the time cycle on some jobs by 25 per cent," he added.

Cramer makes synchronous timing motors and precision electrical timers for commercial, industrial and military uses. Cramer's line of internal timers, time delay relays and others must meet the most critical specifications for structural and operating accuracy.

A typical precision job at Cramer is the machining of pinion posts for hermetically sealed timers which must meet rigid military specifications. Machining—on a Brown & Sharpe automatic—includes feed, rough turn, finish turn, form, cutoff and slotting.

Several years ago, Mr. Perzanoski's department was using 7 or 8 different cutting oils. After consultation

Precision machined pinion posts made by Cramer for Type 430H hermetically sealed timers. Piece is of 303 stainless steel, ½ inch long. Machining time 25 seconds per piece. Gulfcut 41C helps speed up this operation.



Wallace J. Perzanoski, left, Foreman of Cramer's Screw Machine Department, checks a timer part with B. F. Kimball, Gulf Sales Engineer. Gulfcut Cutting Oils help Mr. Perzanoski get finer finishes, closer tolerances, at higher speeds.

cycle 25% using Gulfcut . . .

RUN BETTER!

with a Gulf Sales Engineer, they reduced this to two Gulfcut oils, 41C and 31A. These two versatile oils serve for their complete range of tough machining jobs.

"Another feature of these Gulfcut Cutting Oils that our operators appreciate is the non-staining characteristic which makes them easier and cleaner to work with," said Mr. Perzanoski.

How about *your* cutting oil performance? See how Gulf makes things run better in your operation. Just call the Gulf Sales Engineer at your nearest Gulf office, or mail the coupon.

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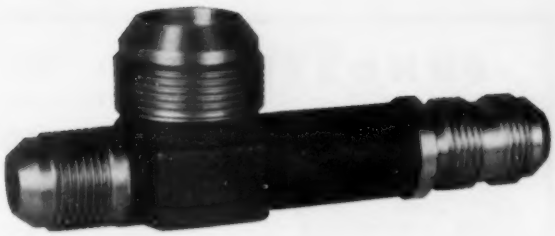
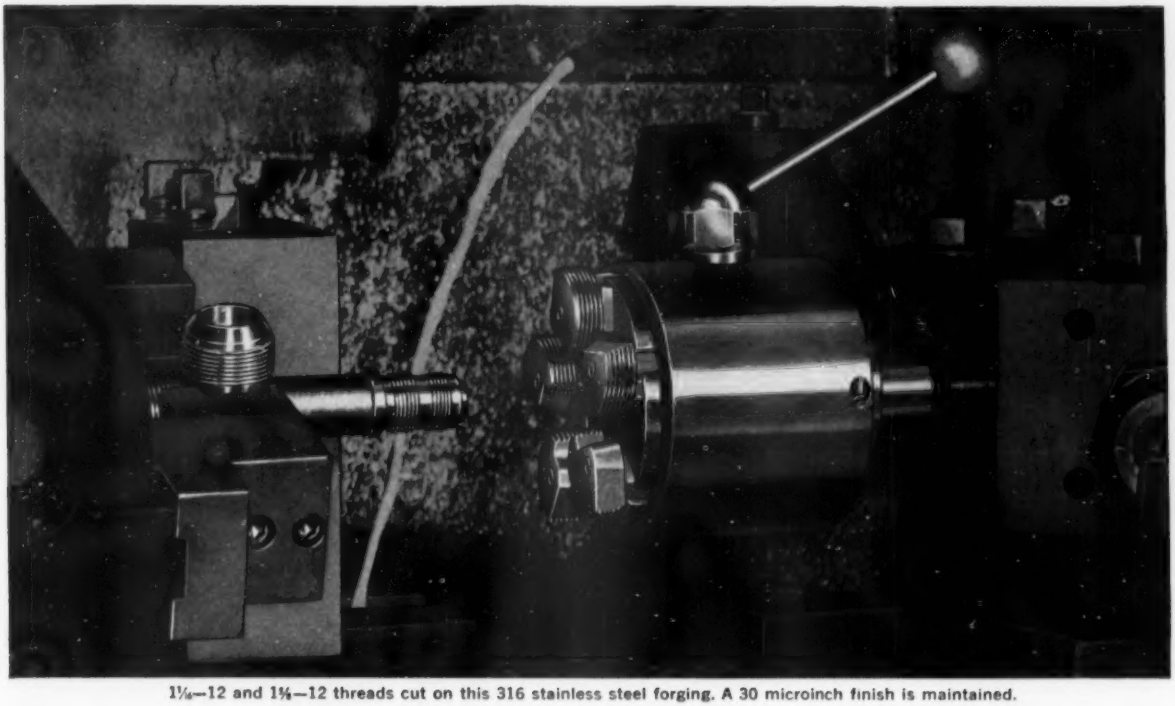
When Threading Specs Read A.Q.R....*



Parker standardizes on 5 Chaser Vers-O-Tools



1⅛—12 and 1⅛—12 threads cut on this 316 stainless steel forging. A 30 microinch finish is maintained.

*"Additional Quality Required" are by-words for this leading manufacturer of precision fittings. The rigid specifications for critical missile components produced in their Cleveland, Ohio plant demand *better than aircraft quality*. "That's why we use Namco Vers-O-Tools almost exclusively," says D. S. Manning, Manager, Parker Fittings & Hose Division, Parker-Hannifin Corporation. "These automatic 5 chaser die-heads eliminate lead error, taper and grooves on the thread flank . . . with overall thread quality at least 50% better than 4 chaser heads. The result is precision fittings with true seating surfaces and a perfect gauge fit."

Prove these facts for yourself: more pieces per grind; precision threading of parts with undercuts, flats, slots; unsurpassed economies in chaser grinding and precise relocation of chasers without readjustment . . . *and* a complete range of sizes. Namco 5 chaser Vers-O-Tools are only a part of a complete line of threading tools designed to provide the tolerances and finish required for *your* toughest jobs. Write for complete information.

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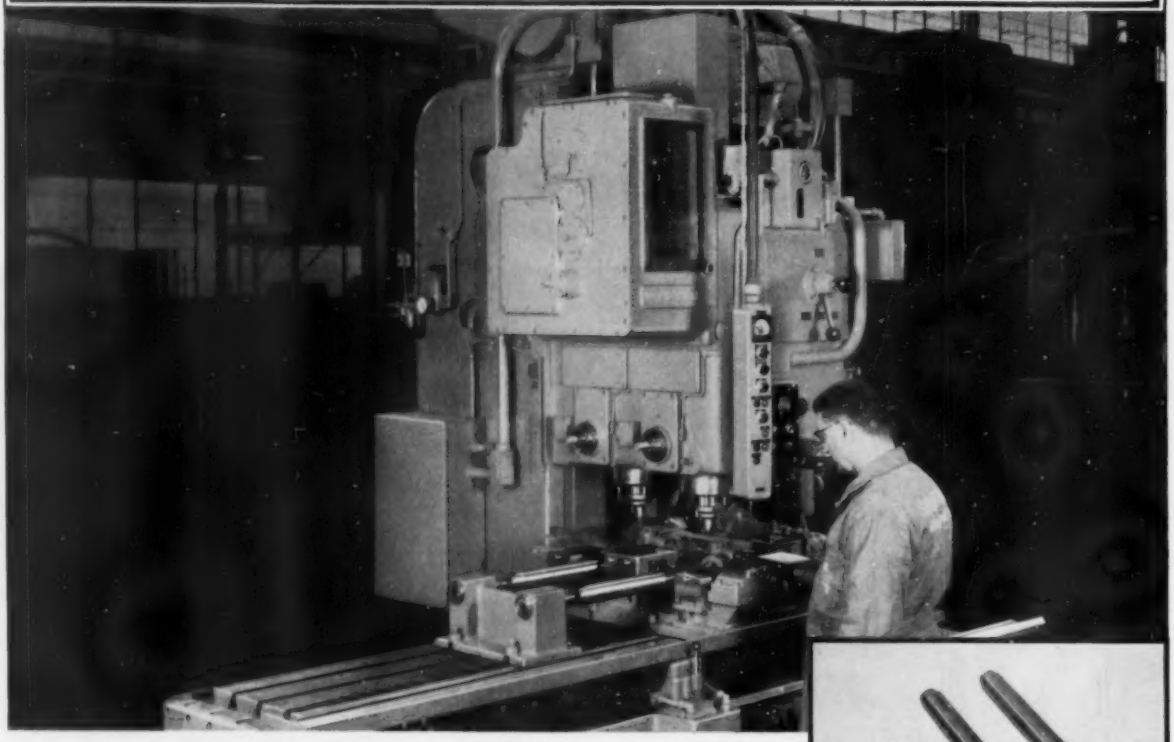
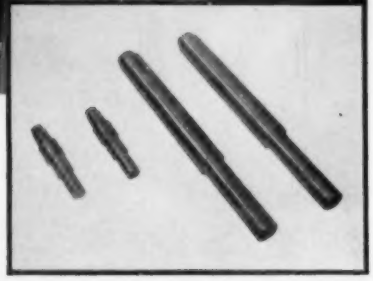
SUNDSTRAND

"ENGINEERED PRODUCTION" NEWS



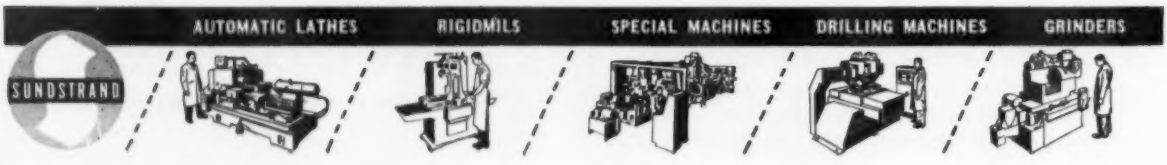


Keyway Milling Time Cut 30% With Sundstrand Rigidmil

Ability to handle a wide range of parts plus fast changeover are outstanding factors contributing to the production increase on this keyway milling operation. Lot sizes range from 50 to 200 pieces with number of keyways per shaft varying from 1 to 5. In addition to reducing machining time an average of 30%, this Sundstrand two spindle Rigidmil simplifies the problem of maintaining required tolrance and finish.

Table feed is controlled by positive, mechanical infinitely variable feed drive that offers feed rate from 0 to 20 inches per minute and a 300 inches per minute rapid traverse rate. The same type of drive is provided for the spindle with speeds available ranging from 100 to 3000 rpm, using a manual shift lever to select the low, medium, or high speed range. Thus, once the operator selects speed range, he can vary speed infinitely within that range.

Fast, positive milling of up to five keyway depths on one shaft is insured by a turret stop on the head. For intermittent keyway milling, machine is provided with vertical feed.



Milling and Centering Machine Boosts Crankshaft Output 2½ Times

With Sundstrand's application of "Engineered Production," major savings can be made in preparing work for machining operations to follow. An excellent example is provided in this installation for milling and centering crankshafts for heavy-duty, air-cooled engines.

Production is now at 400 crankshafts per eight hour shift compared with 152, using former methods. Because both ends are finished at the same time, machining time is reduced materially. In addition, because both milling and centering operations are performed in the same setup, accuracy is higher than with other methods. By eliminating the need for a second machine, floor space is saved and capital equipment requirements are reduced as well.

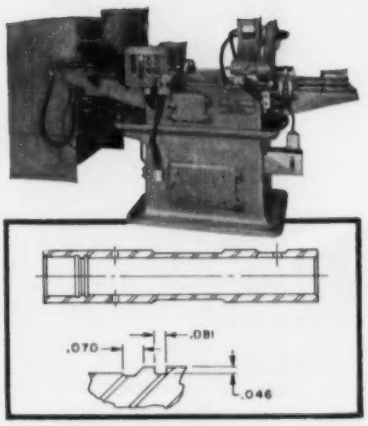
Both cutoff and centering of crankshafts are handled in a single setup on this Sundstrand machine.

Included in the complete line of machines designed for shaft preparation are single end machines for small lot work, double end machines for medium length runs, and broaching and centering machines for jobs where production requirements are high. Automatic loading and unloading can be provided where required for long run production.

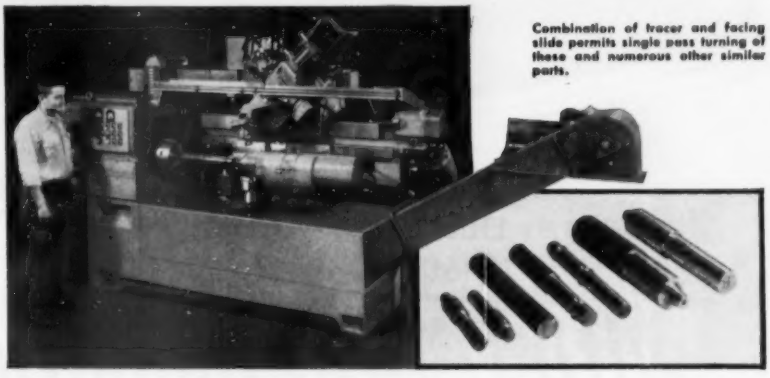
Small Grooves Machined 110 Per Hr. on Thread Miller

Two internal grooves, too small for grinding, are milled and chamfered at 110 pieces per hour on this Hanson-Whitney special 4 x 9 hydraulic machine equipped with automatic loading and unloading. Material is SAE 1062 steel.

Two machines handled by a single operator now do the job that formerly required five machines with an operator for each. All that the operator has to do is load the chute. Workpieces are fed through the spindle, milled and ejected automatically.



Automatic feed and ejection of parts are handled on this Hanson-Whitney thread milling machine.



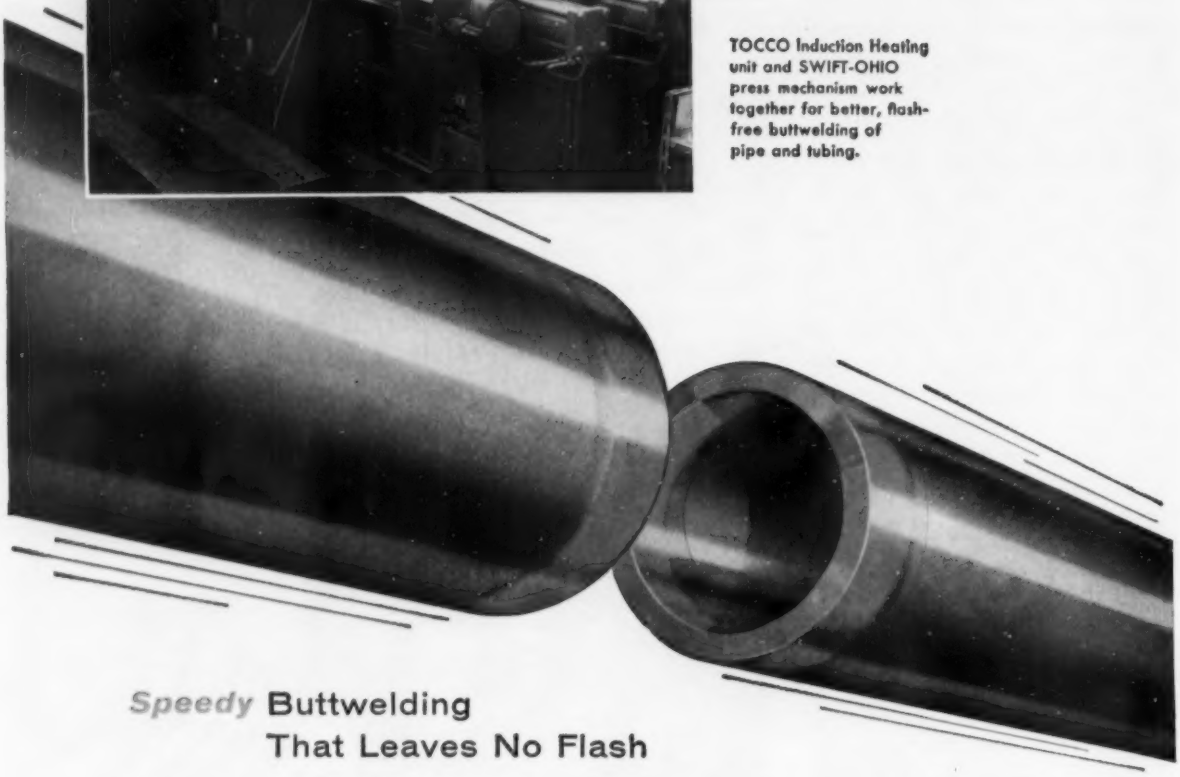
Combination of tracer and facing slide permits single pass turning of these and numerous other similar parts.

One Lathe Replaces Three

It formerly took three machines to do the job now being handled by one Sundstrand tracer lathe in turning the various sizes of shafts shown in the inset. Parts range in size from 1½ to 6 inches diameter and from 18 to 36 inches long. Frequent changes in the size of parts being machined make the job ideal for the Sundstrand tracer lathe that requires only 10 or 15% the changeover time necessary on other machines. Valuable extra floor space is released and required tolerances readily maintained. The high metal removal rate makes the machine's suitability for automatic chip removal an important feature in maintaining uninterrupted production.

Bulletin 702 describes the broad line of Sundstrand machine tools. Write for your copy today.

TOCCO Induction Heating unit and SWIFT-OHIO press mechanism work together for better, flash-free buttwelding of pipe and tubing.



Speedy Buttwelding
That Leaves No Flash

with TOCCO* Induction Heating

and Press Mechanism by SWIFT-OHIO

Now, in less than a minute you can get flash-free, smooth joints on any size pipe, regardless of its diameter or wall thickness.

Conventional buttwelding methods produce strong, sound joints but leave a brittle flash inside or outside the pipe. Inside flash can seriously impede fluid flow. Particularly on long lengths of pipe, removal of this inside flash is a real production headache—time consuming and expensive.

Whether *your* production bottleneck involves buttwelding, soldering, brazing, heat treating or forging, it pays you to investigate TOCCO as an economical way to do it better, faster and at lower cost.

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Planning

To succeed in any endeavor requires planning—followed by action. The importance of such planning cannot be overemphasized. Our annual membership meeting to be held at Milwaukee this month, April 18-22, is built around the theme "Planning for Profit."

The meeting opens with a two-day Leadership Conference to help the chairman-delegates plan their chapter operations for the coming year, followed by thirteen technical sessions pursuing the same theme and a two-day seminar devoted to the study of controlling manufacturing costs.

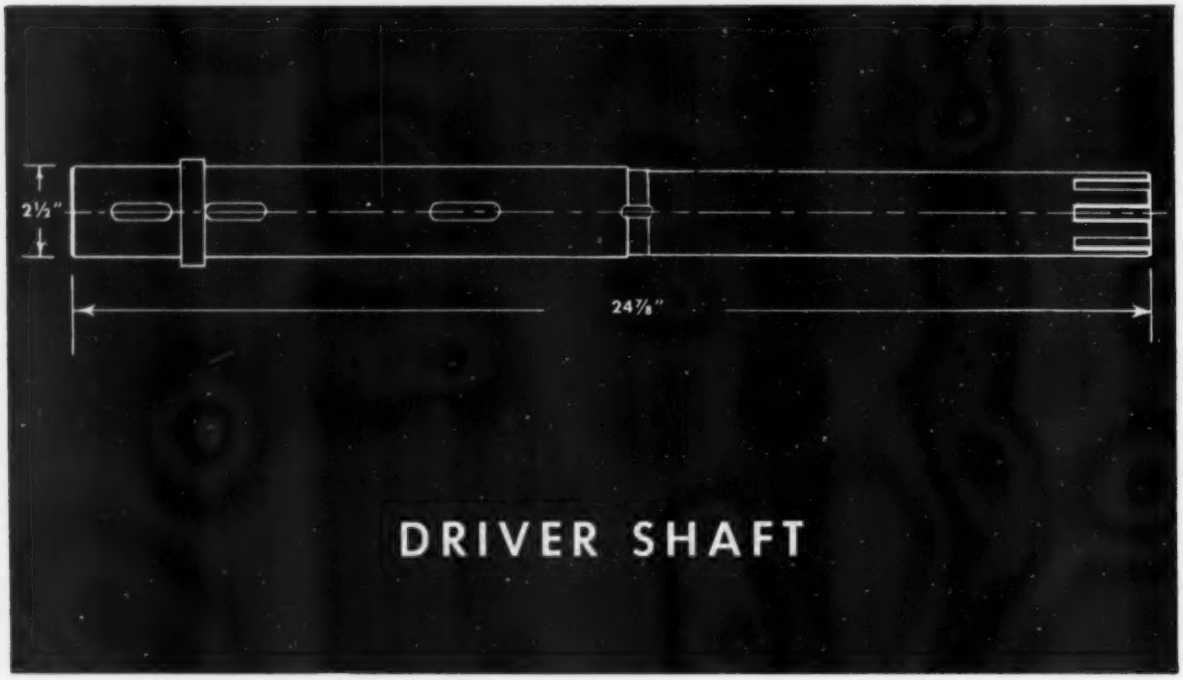
The importance of planning is also well recognized by your Board of Directors and they are currently involved in a series of sessions for long-range planning. This study will include every facet of the Society's operation, reviewing the past and present, and culminating in a planned future for the next ten to twenty years.

We feel confident that this effort will result in preparing the Society for greater service to our membership and industry in the critical decade ahead.

G. A. Goodwin

PRESIDENT
American Society of Tool Engineers

4340 (Brinell 350) vs. Rycut® 50 (Brinell 375)



Rycut 50 Reduces Heavy-Duty Shaft Cost 58%

Costs of material and manufacturing of this shaft at west coast shipyard total $193.40 when 4340 alloy steel is used . . . only $80.80 with Rycut 50, a Ryerson leaded alloy steel.

In addition to cost-savings, the leaded alloy steel has a higher Brinell hardness than the 4340—375 as against 350.

With Rycut 50, tool life is longer; tolerances are easier to maintain; finishing requirements are reduced. Feeds and speeds can be higher, required horsepower is reduced, and short-breaking chips are produced.

Manufacturing costs are further reduced because stress-relieving and heat-treating are eliminated between machinings.

Rycut 50 is but one of many leaded steels available from the Ryerson plant near you. Experienced help in selecting the right steel for your operations is available. Why not look into the cost-saving possibilities soon?

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PLANNING for PROFIT

. . . how seven companies meet the challenge

By T. W. Black
Senior Associate Editor

All successful manufacturing operations show the results of careful planning. Irrespective of the type of product, the basic considerations are essentially the same. These considerations are illustrated by actual examples from outstanding plants that will be visited by ASTE members during the 27th Annual Meeting.

TOOL ENGINEERS live in the future. Tomorrow's production operation reflects today's planning. And, in the words of a distinguished tool engineer, "Anything we can do today we can do better tomorrow."

Is there any basic planning philosophy that can be generally applied? A survey of seven manufacturing companies indicates that there is. Plants of these companies produce a variety of products—electric motors, turbine blades, *Fig.* 1, automobile frames and bodies, power shovels, small and massive gears, to name a few. Virtually every metal-cutting, forming, finishing and assembly operation is represented. The basic planning philosophy is similar in all companies. This can best be illustrated by taking a look at that planning—and the production results—in each company surveyed.

Multiplying Productivity: When a company manufactures a wide variety of products, emphasis is placed on versatile machine tools that have the ability to accommodate a considerable range of workpiece sizes and configurations. This is the case at the Harnischfeger Corp., which produces overhead crawler and truck cranes, excavators, diesel engines, electric hoists and welding equipment.

Harnischfeger engineers find that continuous facilities modernization is an important avenue to reduced machining costs. An example is a recently acquired four motor driven head milling machine, *Fig.* 2. The machine is used primarily for roughing and finishing operations on components for excavating equipment. It is equipped with two tables, each 19.5 feet long and 88 inches wide. These tables can be connected to provide a 39-foot long work surface. Maximum distance between the side heads is 8 feet; minimum distance is 5.5 feet. The maximum distance from the top of the table to the vertical heads is 7 feet. Each of the two rail-

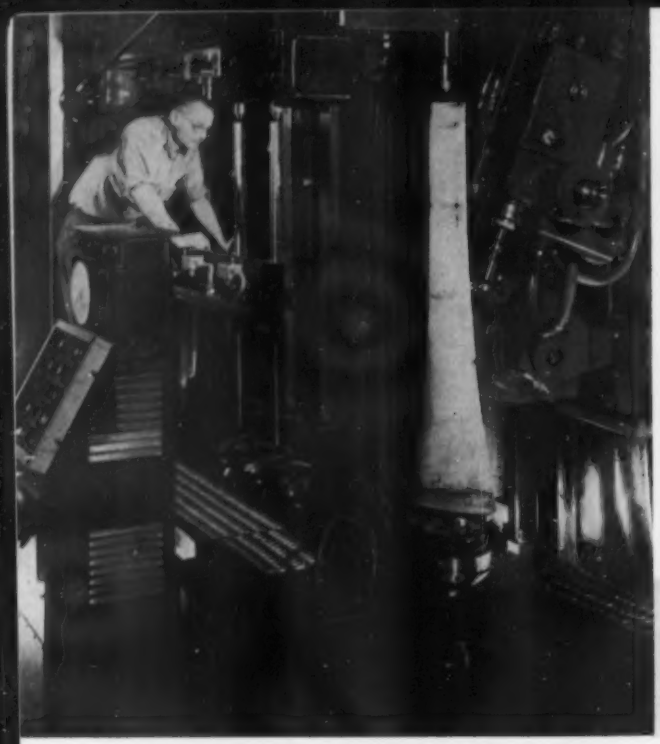


Fig. 1. High-speed four-spindle blade milling machine cutting 46-inch turbine blades at Allis-Chalmers Mfg. Co. This tracer-controlled machine has resulted in a four-fold increase in productivity over single-spindle machines. Operation is automatic.

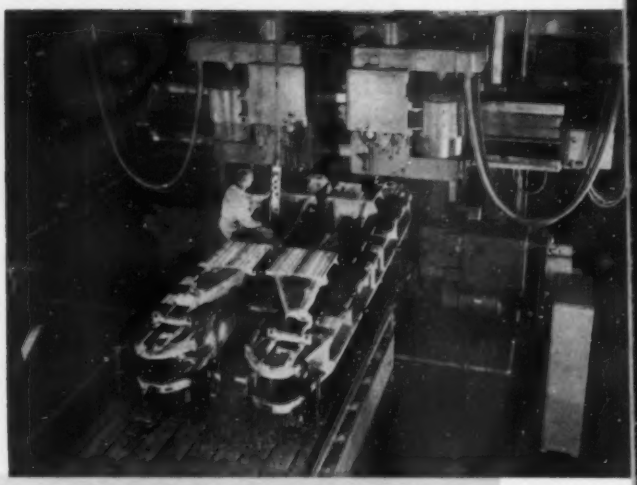


Fig. 2. Modern double-spindle planer type mill has replaced two older machines at Harnischfeger Corp. High horsepower and double tables decrease machining time.

heads is driven by 100-horsepower motors; the side heads are each driven by a 75-horsepower motor. A total of 350 horsepower is available to the spindles. Table speeds range from 1.25 to 120 inches per minute. Spindle speeds are from 15 to 660 revolutions per minute.

Typical workpieces are complex welded steel structures, often requiring turning and boring operations as well as straight milling operations. An attachment permits use of milling cutters in the vertical position (perpendicular to the table), allowing both the tops and sides of workpieces to be machined without changing the basic setup.

Thus the machine is inherently capable of fast, efficient operation. It performs the same work formerly done by two older type planer mills, with consequent savings in manpower, in floor space and in maintenance costs. Also, somewhat closer tolerances can be held with the new machine.

Harnischfeger engineers attribute the improvement to four factors:

1. Use of twin tables
2. Efficient operating crews
3. Work standards
4. Utilization of carbide tools.

A large milling machine, like any other machine, makes money only when it is cutting metal. The twin tables permit maximum utilization of machine time for productive operations. When one part is being machined, a second part can be set up on the other table. Little time is lost in changing over from one workpiece to another. The tables are locked together for machining long workpieces.

There are three crew members, each of whom has definitely assigned duties during all phases of setup and operation. A machine operator is in complete charge of the machine and directs the other crew members, as well as handling all controls. A machine loader, the second crew member, loads and sets up the table that is free during the machining operation. The third crew member, a helper, cleans up chips and helps the loader to clamp workpieces in place. When the tables are connected for long workpieces, all three crew members cooperate in the setup and loading operations.

Using twin tables and assigning definite responsibilities to each crew member do not, of course, guarantee that optimum productivity will be attained. A great deal depends on the attitude of the crew. At Harnischfeger, between 85 and 90 percent of all operations have been placed on an incentive plan. Work standards are developed for each job to determine production rates at 100 percent (normal) efficiency. If a crew turns out, say, 20 percent more production than called for by the work standard, each crew member receives 20 percent higher hourly pay. This is a powerful stimulus toward improved efficiency.

Work standards are developed by industrial engineers from time study data. The machining practices on which the standards are based are established with the cooperation of plant super-

vision and the operators themselves. Each standard is broken down into setup time, unit machining time and tear-down time.

Because of the high horsepower and rigidity of the milling machine, it is possible to use carbide tooling almost exclusively. Carbide tools have resulted in substantial increases in productivity, as compared to the older equipment. Speeds when milling structural steel with the old equipment were from 80 to 110 fpm, using high-speed steel cutters. Feeds ranged from 3.5 to 12 ipm. With carbide tooling on the new machine, speeds are from 200 to 300 fpm and feeds range from 18 to 30 ipm. These figures are for roughing operations and ¼ to ⅜-inch depths of cut. Tool life is about 5 hours.

Additional machine flexibility is provided by a boring attachment, *Fig.* 3. Rough boring is accomplished at 260 fpm with a 1.6 ipm feed. Finishing speed is 310 fpm at a 2 ipm feed. Tolerances are held within 0.002 inch and surface finishes are approximately 125 microinches.

Considerable ingenuity has been used in developing tooling for individual workpieces. In one instance, *Fig.* 4, a milling cutter is positioned upside down on the spindle to allow machining the underside of a flange. The spindle follows a circular template mounted on top of the workpiece. With the template, the machine operator has no difficulty in following the circular contour of the flange. The operation is performed on the same basic setup used for milling the top of the part and performing the boring operation illustrated in *Fig.* 3. If the "upside down" milling arrangement had not been devised, it would have been necessary to perform the operation on a vertical turret lathe.

"Automatic Factory" Today: The A. O. Smith Corporation's Milwaukee automotive plant produces chassis frames for many of the nation's passenger vehicles and trucks. The frames are produced from hot rolled steel which enters the plant as plate or sheet and which is converted by press operation into structural stampings which are assembled by welding and riveting.

A. O. Smith was the pioneer of this frame making method having produced the first pressed steel frame for Peerless Motor Car Company in 1903. Since that time 60 million frames have been produced.

Just after World War I, A. O. Smith developed one of the first large scale automatic factories. Their automated frame plant during the '20's could produce the relatively simple frames of that time at the rate of more than 10,000 per day. Handling as well as most of the productive operation was accomplished mechanically. Since that time, however, as a result of increased product complexity, more frequent and radical model changes, and differences between frames for different body styles, flexibility and adaptability to change have become the important requirements for productive equipment.

Accordingly the present passenger frame assembly plant involves individual, semiautomatic lines for the several major customers. Each of these embodies conveyors which transport the parts through sub-assembly stages and into final assembly after which they are straightened and painted.

Dimensional accuracy is of extreme importance and it is necessary that all critical attaching points be rigidly held in location during the successive assembly steps. Hydraulically actuated fixtures give positive location and in many cases are tied with the welding circuits in such a way that welding cannot be accomplished until all of the clamps have reached their closed positions. Fixtures are designed to maintain accuracy in spite of hard production usage by such design features as sealed ball bearings, the use of bronze parts in areas subject to weld splatter to prevent adherence of the molten metal, and the use of high alloy materials on parts subject to wear such as pilots. The design of the frame assembly lines gives consideration to optimum positioning of

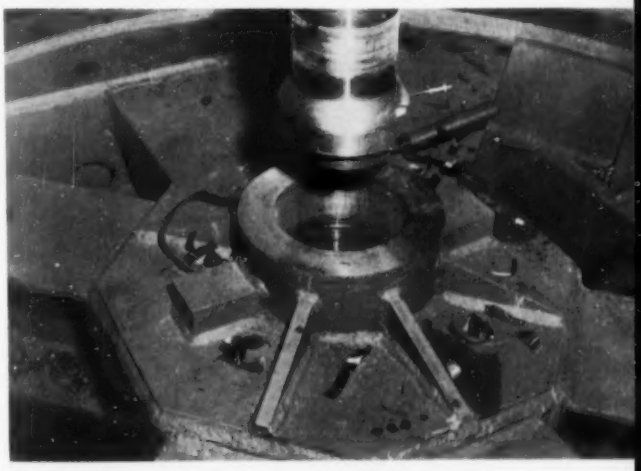


Fig. 3. Boring six-inch diameter hole on heavy weldment is accomplished with carbide tooling. Tolerances within 0.002 inch are held.

the work for the convenience of the operators in welding and other assembly operations. It also features maximum adaptability to the changes in components required by the different frames for various body styles and by the changes from one model year to another.

Automatic straightening is accomplished at the end of the passenger frame assembly line by the use of a device which senses the dimensional variations which have occurred due to weld distortion and which then deflects the frame the amount required to bring it into proper alignment. After each

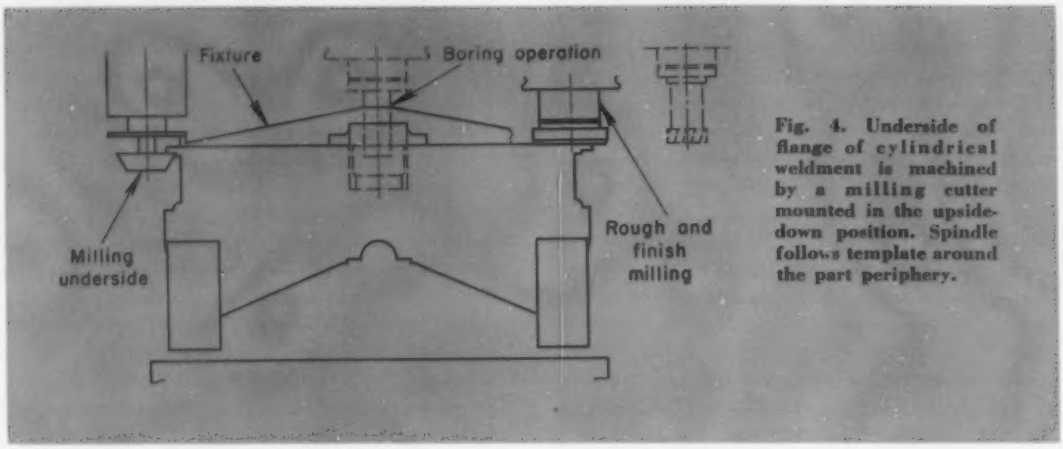


Fig. 4. Underside of flange of cylindrical weldment is machined by a milling cutter mounted in the upside-down position. Spindle follows template around the part periphery.

straightening cycle, the machine re-senses the frame dimensions and makes further corrections if necessary. When all dimensions are within tolerance, the frame is transferred to the paint conveyor.

Small assemblies are automatically welded by the CO_2 shielded-arc process. Once parts are clamped in place, the welding head strikes an arc and makes the required seam. This process produces uniform welds at high rates of travel. Some of these fixtures have unusual clamping arrangements. Sections of sealed fire hose serve as actuators for the clamping mechanisms. When these are filled with shop air, they force the components to be welded (a web section and two flange sections) into contact and hold them firmly in place. After the welding operations are completed, air is exhausted from the hoses and the parts can be easily removed.

Smith welding engineers have developed a new process known as penetration welding. At present it is used in production for spot type welds. A CO_2 shielded arc torch is utilized with a $\frac{1}{16}$th-inch diameter wire electrode. When the electrode is applied to the metals to be joined, a hole is rapidly melted through the upper part. A pool of molten metal is formed. When this metal solidifies, metal in the two components is permanently joined.

The resulting weld is stronger than a spot weld or riveted joint. It has an additional advantage over riveting since it is not necessary to make holes in the parts prior to fastening. Duration of the welding cycle is preset on a timer so there is no danger of burn-through. The welding head is of the pistol type: the operator merely puts the electrode in contact with the work and pulls the trigger. Four or five welds can be made in a few seconds. Productivity is enhanced by the light weight and small size of the gun, as compared to conventional spot welding or riveting guns.

The frame, with the exception of a few brackets, is entirely of sheet steel that is blanked and formed in the Smith plant. Recently, Smith engineers have adopted soap lubrication for sheet stock, rather than the usual oils. They find that soap solutions are somewhat better high-pressure lubricants than oils and they are much cleaner. A soap-and-water mixture is applied to the raw stock after washing and is dried as it passes through a continuous oven, leaving a thin film of soap. This lubrication makes the sheets easier to separate, as well as making it easier to slide a sheet or blank off the top of a pile for press operations. Soap lubrication is not sufficient for deep drawing operations, where conventional lubricants are used.

A relatively new form of automation—numerical control—was recently installed on the drilling machine used to prepare master blanks. Location of holes in the master blanks for frame side rails must be exact, since the blanks are used when locating piercing punches in production blanking djes. A special drilling machine is used in blank preparation. It consists of a long table and a traveling

Fig. 5. Single-purpose machine for drilling and countersinking holes in connecting rods was built from standard components at low cost.

drilling head. Previous to the introduction of numerical control, the operator located the drilling head by means of a vernier scale, read through an optical sighting arrangement. While this hole location method was much faster than the conventional layout method using a prick punch, it was still time consuming and operator error was possible.

With numerical control, location and relocation of the drilling head is master-minded by a punched tape prepared in the engineering department. Once the operator has set the head in the "zero" position, all subsequent location operations are automatic. Hole sizes and hole numbers are visible to the operator on a panel.

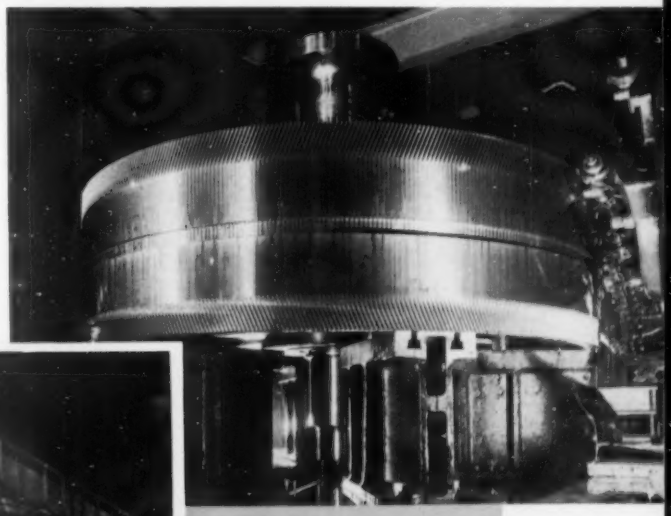
When no tape is available, hole locations can be set directly on a control panel. If, for any reason, the operator wishes to double-check the location of the head prior to drilling, the vernier scale is used to take direct readings.

Keep 'em Moving: Problems of the intermediate-size automotive producer are exemplified in the American Motors Body Plant. Here some 275 tons of sheet steel per day are stamped and assembled into over 600 Nash Rambler bodies, completely equipped with window glass, interior and exterior trim and paint. Although this is high production, volumes are not sufficiently high to justify extensive automation in the pressroom and most assembly operations on major subassemblies and on the body assembly itself are necessarily manual. Extensive conveyorization, however, has eliminated much manual materials handling and most assembly operations are performed on moving lines.

A total of 749 dies is used in making stamped parts and these dies are operated on only 147 presses. Frequent die changes are mandatory. Through a combination of overhead cranes and mobile die-handling equipment, these changes can be accomplished quickly and efficiently. While most blanking and forming presses are manually loaded, belt type conveyors facilitate movement of stampings between successive operations. Completed parts are transferred to storage or assembly areas by overhead monorail conveyors, which also carry them through washing operations.

Virtually all assembly operations are accomplished on moving conveyors, contrary to the usual automotive practice of assembling bodies on stationary fixtures ("body bucks"). Each four-door body has approximately 7000 spot welds, 232 inches of arc welding and 71½ inches of brazing. Assembly is facilitated by the use of special spot welding tips designed to reach into inaccessible locations.

Considerable versatility has been built into the final assembly line for bodies. Conventional and station wagon models with both 108 and 117-inch wheel bases are assembled on the same line, over the same fixtures. This versatility is made possible by designing dual-purpose fixtures. It has the result of eliminating the need for a separate assembly line, with consequent savings in floor space, fixture



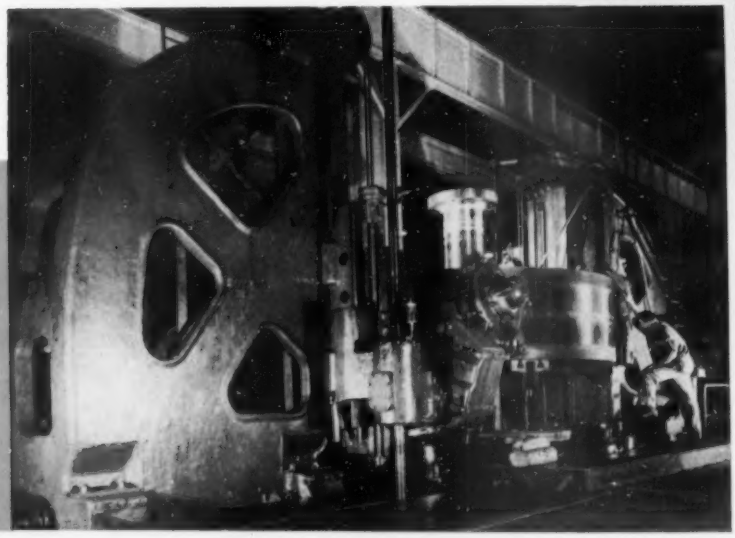


Fig. 6. Eighteen-foot gear machine designed and built by Falk Corp. The gear shown is approximately 10 feet in diameter with a 36-inch face width. High-speed steel hobs are used.

cost and the cost of an additional conveyor line.

A previously vexing problem—applying paint on hard-to-get-at areas of the body—has been solved by applying primer in a 15,000-gallon dip tank, rather than by spray painting methods. Excess paint runs off into drip tanks after the body leaves the dip tank and is reclaimed. Excessive runs are wiped off while the paint is still wet, making it possible to minimize subsequent sanding operations after the paint is baked.

Do It Yourself: Wisconsin Motors, like American Motors, is faced with a need for versatile production equipment. This company is a large producer of heavy-duty air-cooled engines. Production in peak periods is approximately 1200 engines per day. Normally, this volume would call for the use of single-purpose machines, mass-production methods and extensive automation. However, these motors are produced in a variety of sizes and most of them have special adaptations required by their end use. Accordingly, extensive investment in single-purpose machines or automation equipment is not economically feasible.

At the same time, highly productive equipment is desirable to keep manufacturing costs down. The solution found by Wisconsin Motors engineers is to design and build their own single-purpose machines. These machines are constructed from standard indexing tables, standard drilling units and standard air cylinders, plus any special fixturing that is required.

A typical single-purpose machine, *Fig.* 5, which drills and countersinks oil holes in connecting rods, is low in cost, yet has a fully automatic cycle. Production rates are 225 pieces per hour. Another special machine, assembled from standard drilling units mounted on a pedestal, drills eight holes in pistons at a rate of 394 parts per hour. The cost of the machine was $1100. Such "do-it-yourself" machines have made important contributions to efficiency at Wisconsin Motors.

Versatile Tooling: Gears from two inches to eighteen feet in diameter, *Fig.* 6, are among the products of Falk Corp., as are flexible couplings. The gears are incorporated into the company's end products, which include speed reducers, high-speed units, special gear drives and marine propulsion drives. Falk is an integrated organization, maintaining a foundry capable of producing steel castings weighing as much as 35 tons and a fabrication shop where steel weldments are produced.

Most of the gears are produced on standard equipment. Production volumes for any one of the hundreds of gears or drive components are not high enough to permit the use of automation; indeed, the physical size of many of these items precludes conveyorization or other forms of mechanization. Speed reducers, however, are designed with many common components.

In planning for production of these components, Falk engineers try to incorporate as many operations as possible on one standard machine. This is made possible by ingenious fixturing. On a typical gear housing, for instance, all holes are drilled and tapped on a multiple machine. Then the housings are moved to a standard lathe for boring and facing operations, *Fig.* 7. An indexing fixture

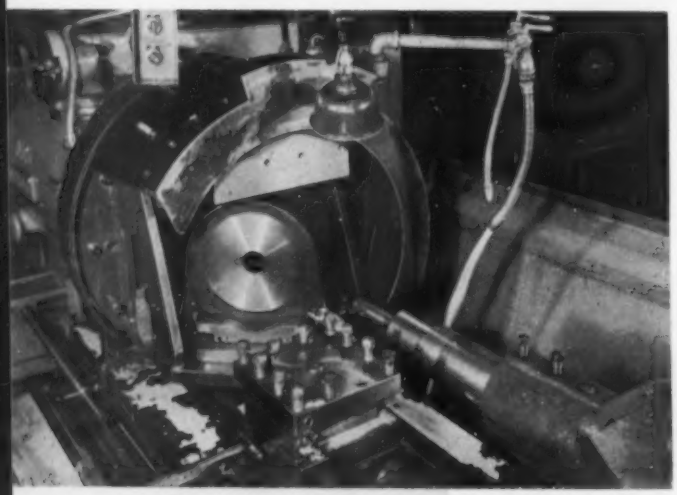
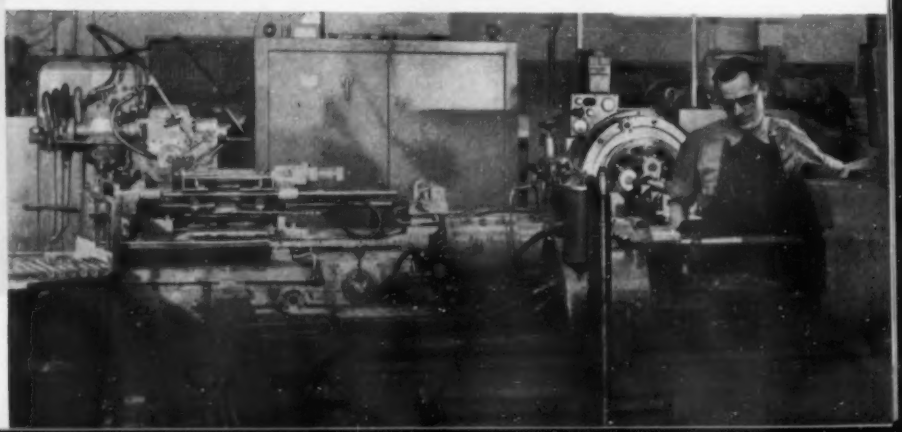


Fig. 7. (above) Both faces of a motor reducer housing are machined in one setup on a Gisholt lathe. Housing is partially indexed.

Fig. 8. (below) Effective layout and automatic operation permit one operator to run three machines at the Louis Allis Co. Lathe in foreground is tracer controlled. Turned shafts are transferred to the thread rolling machine at rear of operator, then placed in a magazine for automatic feeding into a mill.



permits the part to be turned as required for boring and facing operations on both faces.

In another instance, a standard lathe has been converted by adding a three-spindle head. Both sides of the part are machined in the same setup. The operations are finish boring and counterboring. First, boring operations are completed on the side of the part toward the spindles. Then hydraulically actuated pop-out tools are extended for counterboring operations on the other side.

Similar ingenuity is displayed in the fabrication shop where speed reducer housings are assembled and welded. The housing consists of two end plates, several bottom plates and a curved top plate. Normally, the top plate, which is of heavy steel, would be formed in a die operation. Falk engineers reasoned, however, that the end plates themselves, also of heavy steel, could serve as a male forming die. Also, they decided to combine assembly and welding operations.

A hydraulic press is used in the assembly operation. The operator first positions all components of the housing in heavy fixtures on the press bed. When the ram of the press descends, an upper die forms the housing top around the end plates. The operator then checks to make sure that all components are in correct alignment and then, with the press ram still holding the formed top in position, arc welds the entire assembly together. Combining operations in this way, the need for a male die and extra handling of components is eliminated.

Getting the most out of machine tools is a constant responsibility of tool engineers. Falk engineers try to make sure that the maximum available horsepower of each machine is fully utilized. Modern vertical turret lathes in the plant, for instance, have high horsepower ratings and are run at double the production rates possible with older machines.

Ceramic tools have been found to have good promise for some applications in the plant and are currently applied to one production lathe operation for a finishing cut. The ceramics cut steel at 1000 to 1100 fpm, as compared to 750-800 fpm with carbides. In addition, the life of the ceramic tools is 25 percent greater than with carbides.

Return on Investment: The Louis Allis Co. manufactures virtually all types of electric motors, ranging from one horsepower to more than 2500 horsepower. Louis Allis engineers find that the key to production efficiency, when producing a variety of end products, is careful analysis to determine the amount of money that can be profitably invested in machines and tooling. When manufacturing an extremely low-volume part, for instance, hand layout and toolroom methods may be the most economical method. Any investment in special tooling such as jigs and fixtures will, of course, result in more efficient production but, at the same time, will increase unit costs.

Length of production runs is another important factor in controlling costs. From a manufacturing point of view, greatest efficiency is obtained when the greatest number of parts is run from one setup. From an over-all cost standpoint, however, a large production run can be expensive. Storage of materials and finished parts takes valuable floor space which could often be more profitably used for some more productive purpose. In addition, large amounts of money can be tied up in inventories.

Fig. 9. Cell insertion machine automatically cuts, cuffs and inserts cell insulation paper into welded stator cores at the Louis Allis Co.

Allis engineers divide all production into three categories: job lot (five units or less); semijob lot (around 35 units); and production lots (60 or more units). These are the average lengths of production runs in each category. Production methods are tailored to the quantities involved. Punching operations on laminations are an example.

For job-lot runs, laminations are individually blanked in one press, then the blanks are transferred to a second press for double notching operations. The blanks are manually loaded directly on the die. Notching is followed by a separating operation on a third press. Production is about 4000 laminations per shift for each press.

For semijob-lot runs, blanks are loaded into press feeders and are automatically loaded onto the die, punched and unloaded. With this method, production is close to 12,000 lamnations per shift, for a group of three presses.

A third method is to perform all blanking, notching and separating operations on a progressive die. The press is fed with coil stock and all operations, including scrap removal, are fully automatic. This method eliminates the need for individual blanking and separating operations, and increases production to 40,000 per day.

Louis Allis engineers improve efficiency of high-production operations by providing tracing attachments and automatic parts feeders where possible. An example is a series of machining operations on a small shaft, *Fig.* 8. This shaft is cut to length and centered in the steel warehouse prior to delivery to the shaft line. The shaft is turned on a lathe, using a double template. Several roughing cuts are made under tracer control, followed by finishing cuts. After one end of the shaft is finished, it is manually indexed 180 degrees and the other end is machined. A cutting speed of 450 fpm is maintained, with a 0.016-inch feed. The material is 1045 hot-rolled steel. Clamped-on tools are used.

The finished shaft is then fed into a thread rolling machine, butting against a stop. Threading dies automatically come into contact with the part, roll the required threads and then retract. After the shaft is removed from the threading machine it is placed in a magazine feed that drops it into position for machining on a rise-and-fall mill. Here keyways are machined and the part is automatically unclamped and discharged into a hopper conveyor.

Because tracer control is used on the first operation and automatic feeding on the third operation, all three machines can easily be fed and controlled by one operator. The machines are placed so that the operator walks a minimum distance from station to station. Production of this line is 3000 units per week on a two-shift basis.

Some of the assembly operations on relatively high-production products have been mechanized. A Louis Allis-developed machine for inserting cells, for instance, *Fig.* 9, was built from standard components to perform a difficult job.

Motor testing has been conveyorized, *Fig.* 10. Motors are delivered from final assembly on a system of roller conveyors and attached to leads suspended from an overhead conveyor. The motors themselves are carried through test operations on a belt conveyor. When a motor does not meet test specifications, that fact is indicated on a master control panel and, at the same time, lights indicate to the test operator the area where the defective motor is located. As many as 80 motors per hour can be automatically tested on the conveyor.

Facilities Planning: Production at Allis-Chalmers Mfg. Co. ranges from low-volume products such as massive steam and hydraulic turbines to high-volume production of tractors. Accordingly, tooling programs for specific components may range from production on a standard machine without

Fig. 10. (above) Automatic motor test line. Motors are hooked to leads suspended from carrier on overhead monorail conveyor and are carried down the line on a belt conveyor. The control panel reports the progress of the various tests and whether the performance of the motor is acceptable.

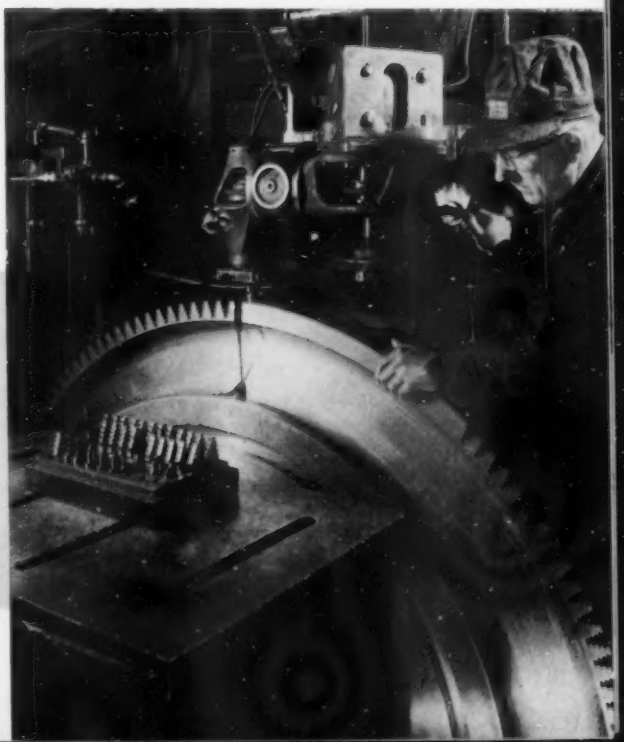


Fig. 11. (right) Original setup for milling axial slots in disk rings for steam turbine rotors.

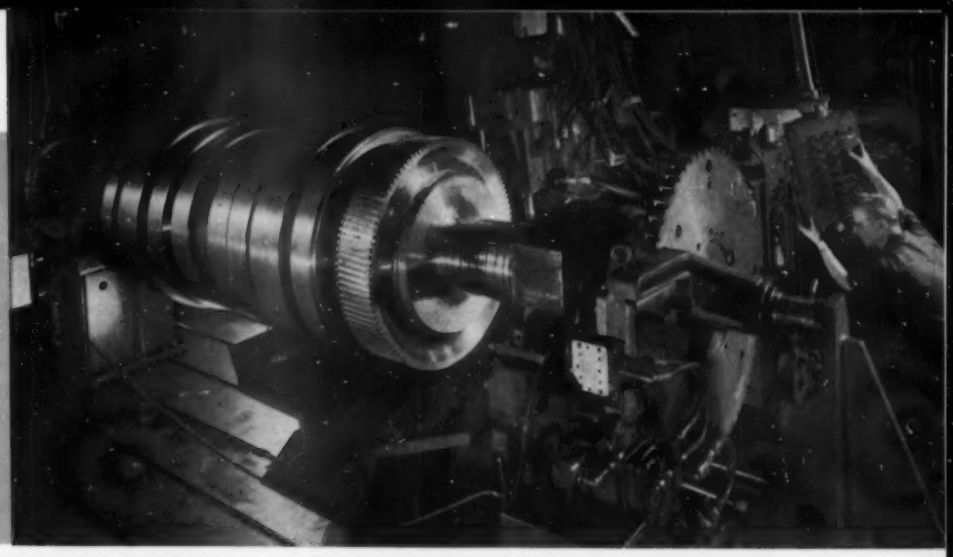


Fig. 12. Improved method for milling slots in disk rings.

extensive special fixturing to the full utilization of automated single-purpose machine tools. Most production falls somewhere between these two extremes.

Facilities planning is conducted on a long-range basis. Some years ago this planning was put on a "perpetual" basis. A continuing analysis of future products and sales forecasts is conducted by a forward planning group. Every two weeks, facilities meetings are held with manufacturing management in attendance to determine the effect of future sales on facilities.

In planning, Allis-Chalmers executives are guided by the fact that equipment should pay for itself in a reasonable length of time. However, they point out that it is not always possible to justify the purchase of a large machine tool on the basis of direct savings alone. Sometimes it is necessary to buy a new machine to improve quality. In other instances, it may be impossible to manufacture a new product without a specialized machine.

Product diversification is a basic philosophy of the company. From a manufacturing point of view, the ability to produce a variety of products requires a diversified complement of standard machine tools, although special machines are used where advisable. The special machines are designed with as much versatility as possible so that they can be used on a large number of products. Other special machines are designed to cover a line of similar products in different sizes. Controls on similar machines are standardized where feasible so that an operator can change from one machine to another without the need for an extensive familiarization period. To reduce tryout time on special machines, speed-and-feed and related operating information is developed by the tool and maintenance department.

When considering new machines, horsepower requirements are studied for present and future needs. Carbide tooling is used extensively, permitting operation at higher speeds, and some applications for ceramic tools have been found. At present, such applications must be individually engineered. While preference is given to carbide tools, including the newer, more shock-resistant grades, high-speed steel tools, with their ability to take heavy cuts at slower rates of speed, are still very much in the picture. In some high-speed steel applications, three-pound chips are cut.

Allis-Chalmers engineers point out that there is not a straight-line relationship between horsepower and actual cutting speeds. Doubling horsepower does not necessarily mean that speeds can be doubled. At high speeds, a considerable amount of power is required to overcome friction.

It has been found that standard machines can be adapted, through special tooling, to combine operations and reduce costs. In one case, nine operations, performed on two machines, were reduced to two operations on one turret lathe.

When studying the need for machines to manufacture new products, the possibility of altering other machines to do the job is studied. An example is the conversion of a used boring mill into a special drilling machine. Three special machines would have been required to produce a specific part. The cost of the machines was estimated at $135,000. Conversion of the boring mill cost about $20,000.

Modernization of older machines is also an important means of cutting costs. A 50-year-old 28-foot boring mill was rebuilt and modernized at 40 percent of the cost of a new machine. Horsepower and speed were tripled, the load capacity of the machine table was increased and other modifications were made so that machining accuracy was improved. An added saving over the cost of a new machine was that the need for a new foundation was eliminated. A foundation for a large machine often has a five-figure cost.

Allis-Chalmers engineers recognize that no manufacturing method can be considered perfect. The normal evolution of improved machines, the application of creative though to devise new methods,

and the pressures for faster, more efficient production combine to add weight to an old truism: "There is nothing so permanent as change."

Machining axial blade grooves in spindles and rings for steam turbines is a case in point. Initially, these operations were performed on a converted planer. The table was fastened in place and milling and broaching heads were added, with an indexing mechanism to hold the disk or spindle, *Fig.* 11. Each head was equipped with its own travel mechanism. This setup was slow and not fully as accurate as later machines. An added disadvantage was lack of capability for machining angular grooves.

A second machine, *Fig.* 12, was capable of machining angular grooves and was considerably more productive, with improved accuracy. This machine is equipped with two milling heads and one broaching head. Roughing operations are performed with a vertical spindle and special side cutting milling cutters. Form relieved end mills in a horizontal spindle finish mill the slots, leaving stock for broaching, and the grooves are broached to final dimensions with broaches mounted in a four-station turret. Indexing is by pushbutton control and a set of interlocks prevents machining until after indexing.

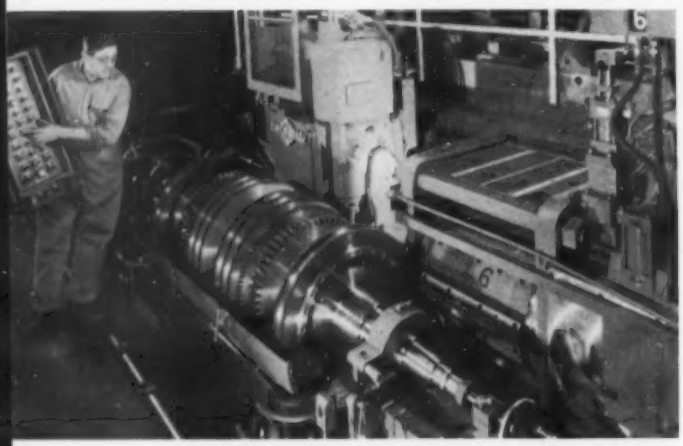


Fig. 13. Third machine for milling slots is equipped with a broaching head having a six-station turret.

A further gain in productivity and accuracy was realized with a third machine, *Fig.* 13, which is equipped with a broaching head having a six-station, turret, in addition to a milling head. Up to six sets of broaches, with a total length per set of 24 inches, can be accommodated in the turret head. Indexing is controlled by pushbutton; all other operations are automatic. Productivity of this machine is greater than that with the second machine.

In tractor manufacture, tools and tooling are of more conventional types. Machines are located for in-line operation as much as possible. The plant is laid out to permit the continuous flow of materials, component parts and assemblies. In this sense, the entire plant can be regarded as one production line. Major subassemblies are built on feeder lines, then transferred to the final assembly line. Consequently, the final line is surprisingly short.

Single-purpose machines, including transfer machines, are used for cylinder blocks, crankshafts, gears and other parts. When the purchase of a single-purpose machine such as a transfer machine is contemplated, product designers are consulted to determine how the machine fits in with long-range product planning. This cooperation is necessary for two reasons: a single-purpose machine designed for a specific product may become obsolete before a full return is realized on the investment if major product design changes are made; also, if a decision is made to keep a single-purpose machine until it has paid for itself, the product designer must keep future products within the design limits imposed by the machine. Either eventuality is to be avoided.

There are many basic rules of tool engineering that are applied in the seven plants studied. They can be summarized in a list of twelve points:

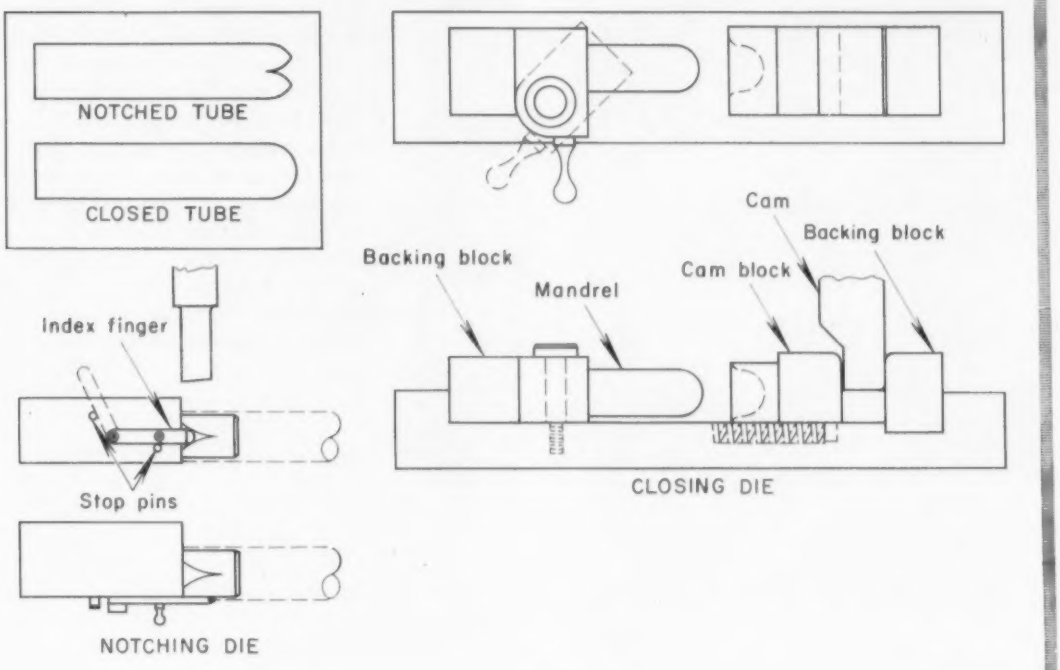
1. Use modern machine tools
2. Run those machines at the highest speeds and feeds consistent with quality and economical performance—get the most out of your machines
3. Use automation where it will pay—but don't overautomate. Retain flexibility
4. When planning for production, keep future product design and volume plans in mind
5. Consider designing and building special-purpose machines from standard components
6. Try to perform as many operations as possible on one machine with one setup
7. Keep tooling versatile—try to design it to accommodate the largest possible range of present and future product designs and sizes
8. Plan layouts for the smooth, uninterrupted flow of materials and parts—and for operator convenience
9. Preplan all jobs and apply work standards and incentives
10. Keep in touch with new developments and new processes—they may solve a pressing problem or greatly increase manufacturing efficiency. There is always a better way of manufacturing any product
11. Control the size of inventories—parts in storage represent idle money
12. Know your costs. Get the most productivity possible with the least investment in tools, floor space, inventory, jigs and fixtures, and manpower.

A final rule: know your product—be familiar with all the possible ways of making it—then apply your imagination to find a better way.

That is the challenge of tool engineering. Tool engineers in the plants studied agree that a successful personal response to this challenge is its own greatest reward.

Gadgets

Ingenious Devices And Ideas To Help The Tool Engineer In His Daily Work



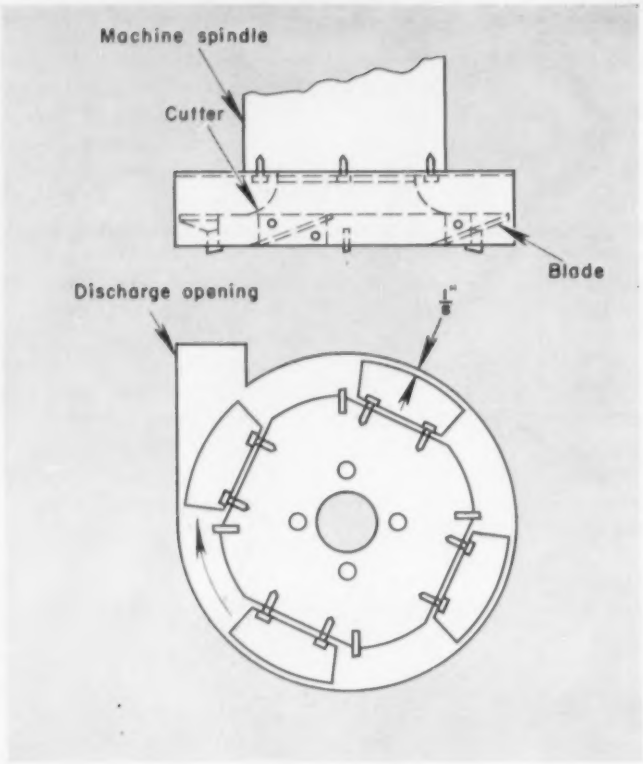
Tube Closing Die

Closing the ends of brass tubes was something of a problem until the cam-operated die illustrated was designed. The tubes are 6 inches long, with 1¼-inch inside diameters. Wall thickness is 0.042 inch. Use of backing blocks behind the cam and mandrel insures effective closing of the tube. As a safety feature, the mandrel swivels for loading and unloading; there is no need for an operator to put his hands into a potential danger zone.

Tubes are notched prior to closing. This operation is accomplished in a notching die equipped with an indexing finger to insure correct notch spacing. After the notching and closing operations, the seams are brazed and polished.

Charles Spicer
Grand River Chapter

Contributions for these pages describing short cuts for the tool engineer are welcome. Finished drawings are not necessary. Honorariums for accepted articles are sent upon publication.



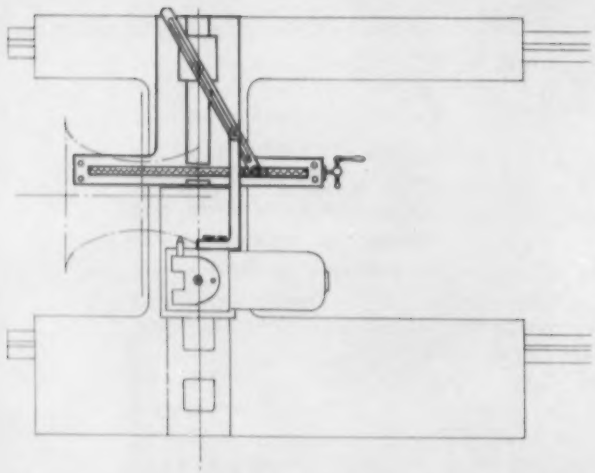
Chip Control Device

For housekeeping and safety reasons, it is desirable to have some means of confining chips to the immediate work area. Large enclosures around the machine often interfere with checking the workpieces and hinder the operator. Another solution is to put a hood over the cutter itself. The hood illustrated was developed for use in conjunction with a vertical mill. Large aluminum billets (15 x 5 feet) are milled at 3600 rpm, using a 12-inch diameter facing cutter.

Four blades are attached to the periphery of the cutter. These blades are set at an angle so that they lift the chips and transport them to a discharge opening in the hood. In this way, the flow of chips is confined to a small area. Operators can safely cut in both directions without having to avoid flying chips, substantially increasing production.

W. S. Ball
Toronto Chapter

Machining an Elliptical Shape



SETUP FOR MACHINING CONCAVE ELLIPSE

When templates and tracing attachments are used to turn an ellipse, the accuracy of the finished workpiece can be no better than the accuracy of the template. Producing accurate templates is time consuming and often involves tedious hand filing. With the lathe attachment illustrated, true ellipses can be generated without the need for templates.

Major components of the attachment are a T-shaped bracket mounted on the lathe carriage, a pivot frame secured to the lathe compound and a connecting rod that links two sliding blocks on the bracket. A dovetail on the underside of the bracket is fitted to the lathe cross slide rail in order to secure an exact alignment with the cross slide. On the upper side of the bracket there is a longitudinal slot and a cross dovetail way that is perpendicular to the slot and parallel to the cross slide. One sliding block slides on the longitudinal slot and is operated by the handle of a feed screw, which is engaged with an internal thread on the block. A second sliding block moves freely on the cross dovetail way.

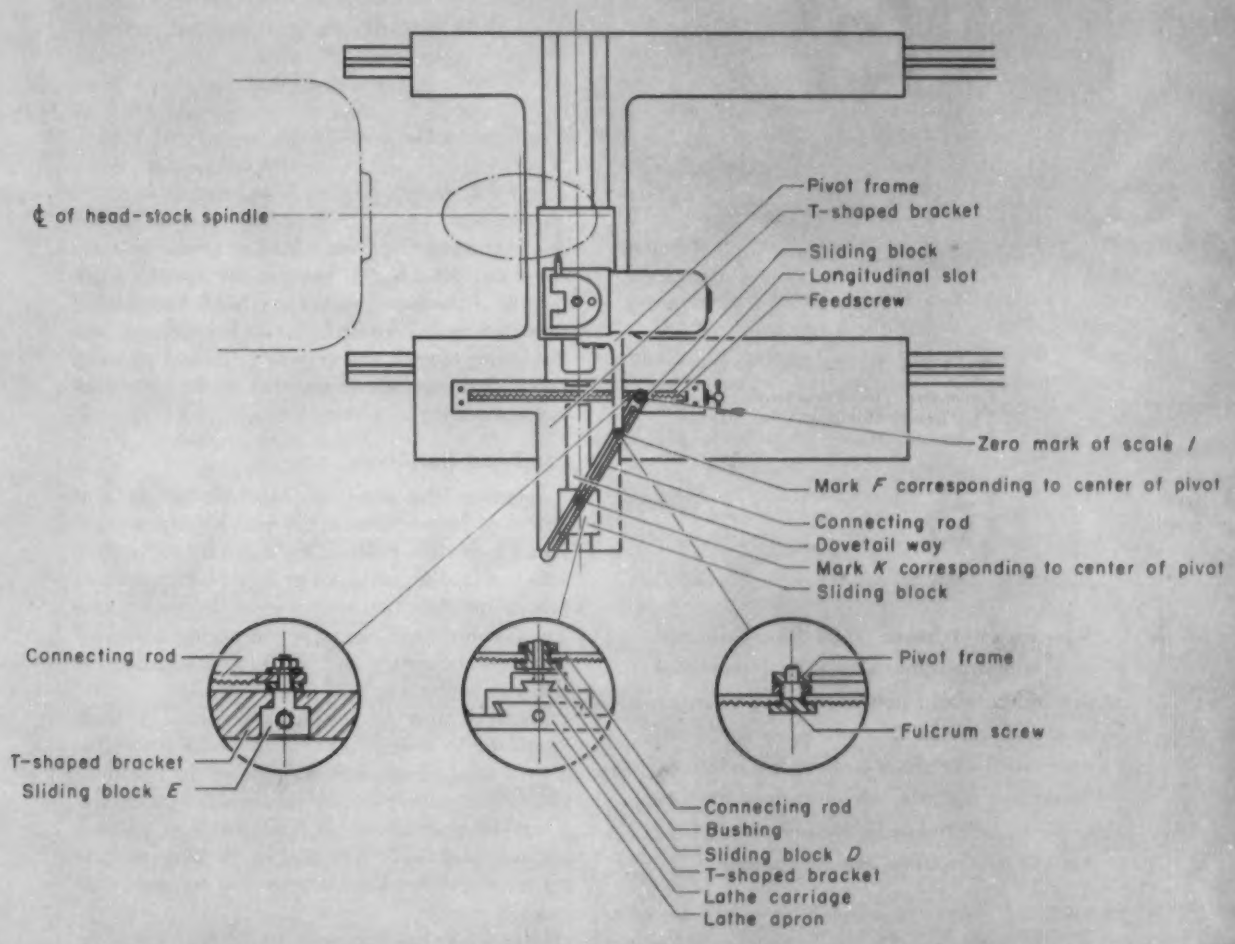
As the first block is operated to slide on the longitudinal slot, the second block, actuated by the connecting rod, moves simultaneously along the

cross dovetail way. During this movement, any point between or outside the pivot points of the sliding blocks in the connecting rod will generate a true ellipse, with the exception of the middle point, which generate a circle. A slot running most of the length of the connecting rod provides adjustment for a wide variety of ellipses.

The methods of attaching the connecting rod to the sliding blocks and to the end of the pivot frame are shown on the drawing. To properly locate the end of the pivot arm and the sliding block on the cross dovetail way with respect to the connecting rod, a scale of inches from the pivot center of the other block is calibrated on the side of the connecting rod. Zero is at point *I* and marks are located at pivot points *F* and *K*. The minor radius is set by adjusting the distance *IF*; the major radius is set by adjusting distance *FK*. Once all elements are in the desired position, nuts are tightened so the position can be maintained.

The cutting tool is set with the connecting rod in a position parallel to the cross slide. Here the tool is at the middle of the ellipsoid and the distance between the cutting edge and the center line of the lathe is the minor radius of ellipse. Concave elliptical surfaces can be machined by mounting the attachment on the opposite side of the cross slide.

P. C. Sun, Tainan, China



SETUP FOR MACHINING CONVEX ELLIPSE

making CAPITAL INVESTMENT PAY

By Carl M. Beach
Executive Vice President
The Heald Machine Co.
Worcester, Mass.

Wise investments in plant sites, buildings and machine tools pay off in terms of productivity and profits. It may be more economical to build a new plant or install new machines than to keep obsolete or inefficient facilities in operation. Factors to be considered in long-range capital investment planning are evaluated.

Abstracted from Paper 198, "Capital Costs and You," to be presented at the 27th Annual Meeting. Copies of the complete paper will be available from Society Headquarters, 10700 Puritan, Detroit, Mich.

HENRY FORD ONCE SAID: "If you need a new machine and don't buy it, you pay for it without getting it." The same philosophy holds true for all forms of capital investment—land, buildings, production equipment and inventory. Sound planning in all of these areas is essential to the success of any company.

Land and Buildings

Selection of a plant site calls for the study of dozens of factors. One of the most important is the future expansion plans of the company. Providing sufficient land for proposed or hoped-for expansions can, in the long run, save money. If any expanding plant becomes "fenced in," acquiring additional land may be costly and, in some cases, may be virtually impossible.

Plant location is equally important. A plant should be in a neighborhood that will attract the desired kind of employees. Some of the questions to be asked are: Is the site accessible to public and private transportation? Is it accessible to trucking and rail facilities? Will utilities be adequate? Is the area one that the company and its employees can be proud of?

Once a site has been selected, detailed plant design can be started. In general, it is best to select a type of construction that is functional for the proposed manufacturing operations. Building de-

signs should permit easy expansion in future years. Maintenance costs are continually increasing, so it is wise to select durable construction materials that require a minimum of painting and are easy to clean. When comparing alternative materials and construction methods, the initial cost, plus the maintenance cost over a period of years, for all alternatives should be examined. Then the decision can be based on the least cost over a period of years that is consistent with convenience.

Employees are, of course, the most important asset any company can have. The comfort and well-being of employees are necessarily paramount considerations when planning a new plant. Good plant design can have a definite favorable effect on employee morale and efficiency.

Machine Tools

It is not often that a company is faced with the problem of acquiring a site and building a new plant. There are, however, a number of capital investment decisions that are necessarily made on an everyday basis. Most of these are machine replacement decisions. Such decisions can affect a company's profit picture just as much as selection of a good product to manufacture, selection of personnel and similar factors.

There are a number of valid reasons for replacing production equipment, the most obvious being the fact that a machine is actually worn out and beyond reasonable repair. If this is the reason for replacement, however, the chances are that for many months and perhaps years that piece of equipment has been operating at a loss to the company. Perhaps it has been producing substandard parts; perhaps it has produced parts at so great a cost that the operation was unprofitable.

In order to make sound replacement decisions, records should be kept for each machine. These records can include maintenance costs, down time, cost of tooling and similar information needed to evaluate equipment. With all pertinent information readily available, the need—or lack of need—for replacement is easily determined.

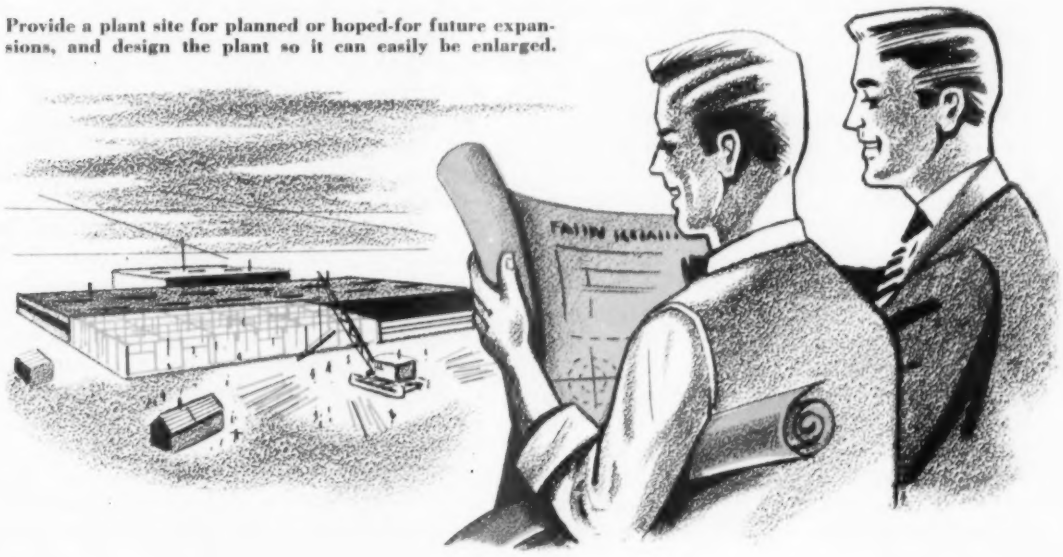
Even when an older machine is in good operating condition, it may be technologically obsolete. Machine tool builders are continually developing equipment that performs faster, more efficiently, more accurately. Often the only way a product can be manufactured and priced at competitive levels is to adopt modern methods.

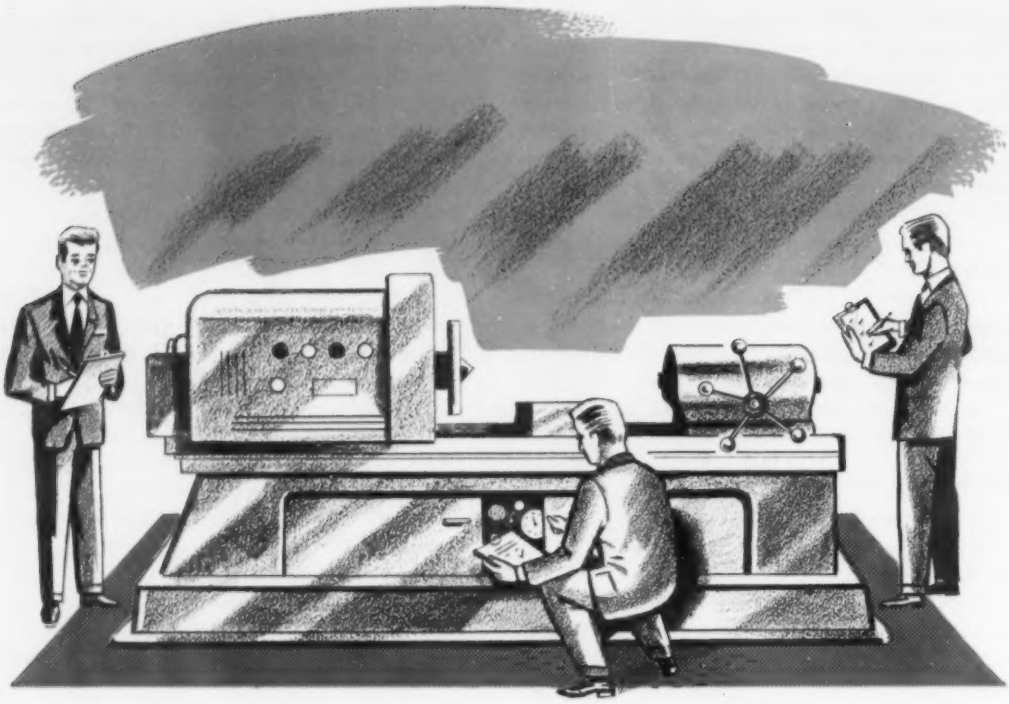
The automotive industry furnishes many examples. Years ago, the exterior surfaces of cylinder blocks were machined by individual milling machines. Each machine performed one operation with high-speed steel or Stellite cutters operated at six to eight inches per minute. Four or five cylinder blocks per hour was the average production rate per machine. To machine the top, bottom and bearing lock surfaces of a six-cylinder block and maintain a production rate of 125 blocks per hour, 75 milling machines, 75 operators and 13,500 square feet of floor space were required.

With the advent of carbide tooling, feed rates increased to 20 inches per minute and cutting speeds doubled. Twenty-one blocks per hour could be obtained from one machine. Thus production of 125 blocks per hour required six milling machines, six operators and 1380 square feet of floor space.

The next step was the introduction of horizontal broaching machines, cutting at 45 feet per minute with high-speed steel cutters. Flatness, squareness and parallelism were held within 0.003 inch—an added advantage. Production of 125 blocks per

Provide a plant site for planned or hoped-for future expansions, and design the plant so it can easily be enlarged.





As much care should be given to the selection of a $14,000 machine tool as is given to obtaining a one-million dollar order.

hour required only two machines and two operators. Floor space requirements were reduced to 750 square feet.

Today, one horizontal broach performs all operations, using tungsten-carbide insert tools cutting at 100 feet per minute. The broach produces 125 blocks per hour and occupies only 375 square feet of floor space. Flatness, squareness and parallelism are held within 0.0015 inch. This series of improvements, along with many similar ones, has enabled automobile manufacturers to keep prices at competitive levels.

A recent example of savings made possible through the installation of a modern machine is the replacement of a surface grinder. The old machine, because of light construction and poor spindle design, could not be used with metal-bonded diamond wheels. A new machine of heavier construction, having a stable spindle, allowed a change from resinoid-bonded diamond wheels to metal-bonded wheels. The savings in diamond wheel cost alone amounted to $5300 yearly.

There are opportunities for improvements of this kind in nearly every field of manufacturing. Standard Pressed Steel Co., for example, has estimated that today's modern machine tools can produce, on the average, 1½ to 3 times more parts than comparable 1945 machines, and with better quality.

Actual Machine Costs: Machine tools unquestionably represent a sizeable capital investment. Standard Pressed Steel Co. executives feel that as much care should be given to the purchase of a $14,000 machine tool as a sales manager gives to obtaining a million-dollar order. It often takes a million-dollar order to supply the profit required to purchase that machine.

At the same time, a modern machine tool is something of a bargain as compared with the real cost of machine tools in other years. If the year 1900 is used as a base, today's wages are 1000 percent higher, construction costs are 550 percent higher, yet production equipment costs have risen only about 400 percent. Thus machines that save floor space, time or manpower are, comparatively speaking, good investments.

Taking a specific example, a company wishes to purchase a machine tool costing $12,000. This machine has an anticipated useful life to the company of seven years and the company has permission from the Commissioner of Internal Revenue to depreciate the machine over the seven-year period.

Depreciation of a machine can be taken by one of several acceptable methods: double-declining balance, sum-of-the-digits or the older straight-line method. The straight-line method is considered the least favorable to the taxpayer, but, for simplicity, it will be used in this example.

The company assumes that the machine can be disposed of at the end of the seven-year period for $3500, leaving a net expenditure of $8500 for the

machine. The $8500 will be written off through depreciation over the estimated useful life of seven years, an allowable deduction for tax purposes. This will result in a reduction in taxes paid, regardless of what the tax rate may be.

Assuming that the company has income, over the seven-year period, that will be taxed at the 52 percent rate, the amount of depreciation to be taken on the machine would be 52 percent of $8500 or $4420. The tax savings of $4420 plus the estimated disposal value of $3500 leaves a balance of $4080—a sum that represents the total cost of the machine to the company. Over the seven-year period, the average cost of the machine will be $583 per year.

If the company operates the machine 40 hours per week and 50 weeks per year, the hourly cost of using the machine, exclusive of floor space charges, wages, maintenance, tooling and power is about 29 cents. Assuming that the machine is operated on a two-shift basis, the hourly cost is 14½ cents. The same principle applies to any piece of new production equipment. New equipment is, if needed, an excellent investment on this basis.

The company, if it actually saves depreciation charges in a separate account, has, at the end of seven years, the tax savings of $4420 plus the disposal value of $3500—a total of $7920 that can be used toward the purchase of a replacement machine.

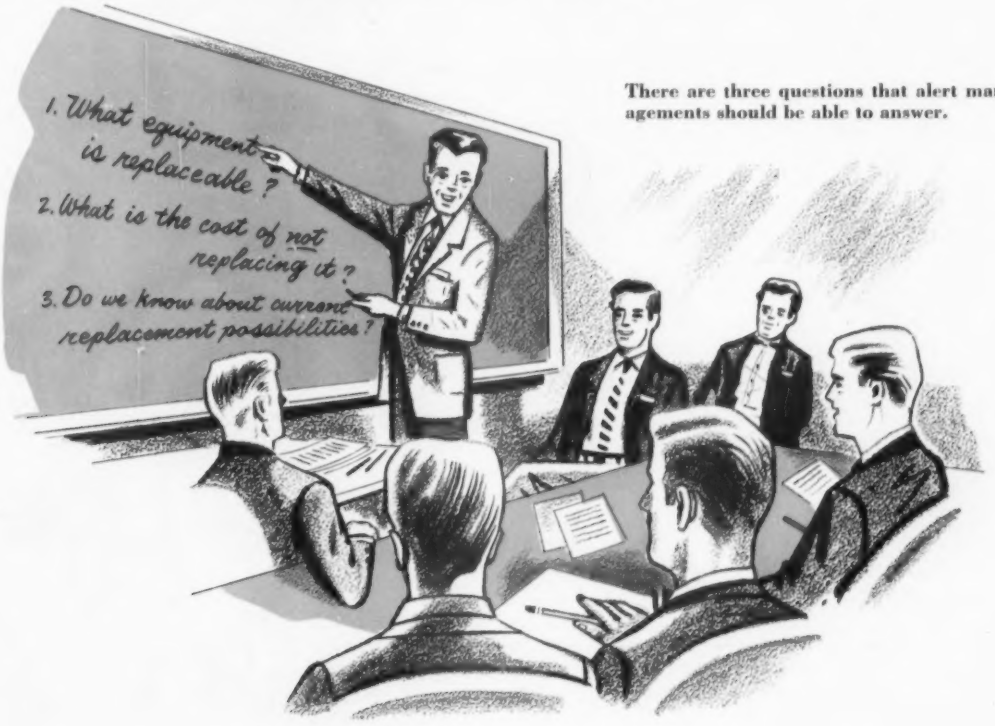
Since the value of the dollar is constantly decreasing, causing the prices of production equipment to increase, it is advisable for a company to spend this year's depreciation dollars for this year's equipment at this year's prices. If this is not done, it will be necessary to add money from profits to the depreciation reserves for replacement.

Inventory

Another capital cost is investment in inventory. Large sums of money can be tied up in raw materials, finished parts and assemblies and completed products. Some of the factors that should be considered when determining the sizes of inventories to be carried are the probable design life of the product, the trend of material costs, the availability of storage space, storage costs, handling costs, possible physical deterioration of the product, taxes on inventories, and the desire and need to provide fast delivery times to customers.

These factors are principally dollars-and-cents costs that can be readily evaluated. There are, however, at least two reasons for carrying seemingly large inventories. At first glance, large inventories may seem to be expensive, but in the long run they may be cost-saving measures.

An example is repair parts. The ability to maintain fast delivery of spare parts is important in maintaining customer good will. A product out of operation waiting for repair parts is of no use to the owner and serves only to remind him of poor service on the part of the manufacturer. In the machine tool field, for instance, there have been cases where customers have refused to buy machines from certain builders simply because of previous poor service on repair parts.



There are three questions that alert managements should be able to answer.

A second example of investment in inventory that may, at first glance, seem excessive, is the situation that occurs when the low level of business indicates the need for temporary layoff of some personnel. From the standpoint of employee morale, it is desirable to keep valued and experienced workers on the job for as long as practical. Hence, keeping the employees busy by increasing inventories may well be desirable.

Utilization of Space

The space within a plant represents a capital cost and must be utilized to best advantage to realize an optimum return on the investment it represents. This does not mean that equipment and workers should be crowded together, but rather that every square foot of space be wisely utilized so that there is a free flow of parts and materials and all materials and components are conveniently located. In many plants, it is noticeable that workers are constantly on the move getting needed items from distant locations and consequently spending a great deal of time getting ready and too little time producing. A study of such a situation will pay dividends. Good arrangement and good housekeeping are tremendous assets to efficient operation.

Often a study of the path a part takes from raw material to finished product indicates the need for new layouts. Revised placement of machines will shorten this route and lessen the need for in-plant trucking and handling. The nature of the product and lot sizes also affect layout decisions.

Replacement Policies

Opportunities for greater profits through equipment replacement exist in most plants. There are three questions that alert managements should be able to answer:

1. Do you know what equipment in your plant is at present economically replaceable?
2. Do you know what it costs your company not to make the indicated replacement?
3. Do you have an organizational setup that keeps you continuously informed of current replacement possibilities?

These questions are advanced in the MAPI *Replacement Manual* and also, in similar form, in the *Replacement Analysis Manual* developed by Cincinnati Milling and Grinding Machines, Inc.

If the answer is "no" to any of the questions, replacement studies should be instituted. The subject of the timely replacement of productive facilities is one that any manufacturing concern must investigate in order to remain competitive. Each company is, of course, struggling to be the best in its field. Intelligent investment of capital costs so that they produce the greatest possible return is the key to successful manufacturing.

Clamp Conversion Speeds Work

A TIME ECONOMY of 40 percent is being realized because of a change from manual to air clamping on a profiling machine at Chance Vought Aircraft. For machining on the three-spindle Keller profiler, 200-pound forgings were held in place by wrench-tightened clamps. These now are replaced by a system of air clamps operated by five air valves. Seventeen air clamps to hold an 11-foot long aluminum alloy forging can be tightened or released by the turn of a hand valve, color coded to match the clamps. Result: the operator can move certain clamps as necessary to permit cutter travel without stopping the operation.

Inboard, outboard upper and lower surfaces of both the left and right hand beams are machined by the profiling tool. Thus only the template needs to be changed, not the tools.

The self-contained clamping system was designed into the machine and the complete unit can be removed to permit milling of other parts. Standard shop line pressure through a two-way air cylinder powers the clamps, which operate in a spiral slot on the clamp post. Should pressure drop below a safe level, a flashing safety light flags the change.

Each wing beam on the Keller machine has its own set of clamps with color coded levers. Whole lever assembly can be removed when another type of operation is done, promoting machine flexibility.

savings through MATERIAL CONTROL

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Cost control of purchased semifinished and raw materials can be a fertile field for savings. The author lists factors to watch and examines them in detail for various kinds of materials.

TECHNOLOGICAL PROGRESS through the years has kept raw materials in ample supply at reasonable costs. However, the importance of materials as an element in the total cost of manufacturing justifies continuous attention to better material control. The term "material" identifies semifinished goods, parts, or components that are brought into a plant for the purpose of being placed in the production process, as well as basic forms of material such as steel sheet or bars.

The part that materials play in the final cost of some typical products is illustrated in TABLE 1. In general, the more complex a product is the smaller the influence of materials on total value. The manufacturing industries listed were chosen to illustrate industries where materials represent both high and low percentages of total product value. Although instances exist where the portion of selling price represented by material cost is relatively low, this cost becomes significant when total volume is high. When the major cost of production is cost of materials, success of an enterprise may depend on how closely material cost is controlled. There are many factors that contribute to material costs. All of these factors must be viewed in relation to each other; if they are not, savings in one can easily result in excesses in another.

Abstracted from Paper 200, "Key Factors in Material Cost Control," to be presented at the 27th Annual Meeting. Copies of the complete paper will be available for purchase from Society Headquarters.

Product Design

The product design stage is one of the most important points at which to control cost of materials. Once final approval has been given for production, many thousands or even millions of units may be turned out. Hence, a design specification requiring unnecessary or costly materials can result in waste of thousands of dollars over the life of the design.

Function is the top consideration in any design. Appearance, ease of manufacture, and cost must play a secondary role until assurance is reached that the product will do the job for which it is intended. Once the matter of function is resolved, other factors such as strength, performance, cost, appearance, and ease of manufacture must be considered. These factors in turn help to decide the selection of materials to be used and the methods of fabrication that eventually are to be employed.

Generalization on material selection without direction at a specific product is difficult and at best can be misleading. The importance of selecting the most economical basic material is obvious when there is a wide range of prices. Hot-rolled steel strip might cost about 8.5 cents per pound and titanium strip $8.50 per pound or more for example. This price differential can be justified, however, when use of high-priced materials results in better performance and longer product life. Applications of titanium in the process industries exemplify this point. For instance, a valve forged of commercial titanium handled a corrosive and erosive fluid at high pressure for 1680 hours without overhaul, while a stainless steel valve required overhauling after only 70 hours of service. In another case, a titanium shaft for a ferric chloride pump gave 320

Table 1—Cost of Materials in Ten Manufacturing Industries (1956)

Type of Industry	Cost of Materials ($1000)	Value Added by Manufacturer ($1000)	Value of Shipments ($1000)	Percent of Value of Shipments Due to Materials
Metal office furniture	117,700	204,279	322,020	37
Wire drawing	1,167,030	638,069	1,805,150	65
Welded and heavy riveted pipe	447,406	287,483	764,890	62
Metal barrels, drums, and pails	168,666	100,900	268,567	63
Safes and vaults	15,213	35,351	50,566	30
Metal foil	185,429	72,897	258,326	72
Metalworking machinery	427,939	585,253	1,013,192	42
Printing-trades machinery	87,626	200,185	287,812	31
Typewriters	58,202	171,647	229,849	25

Source: U. S. Bureau of the Census, Annual Survey of Manufacturers, 1956, U. S. Government Printing Office, Washington, D. C., 1958.

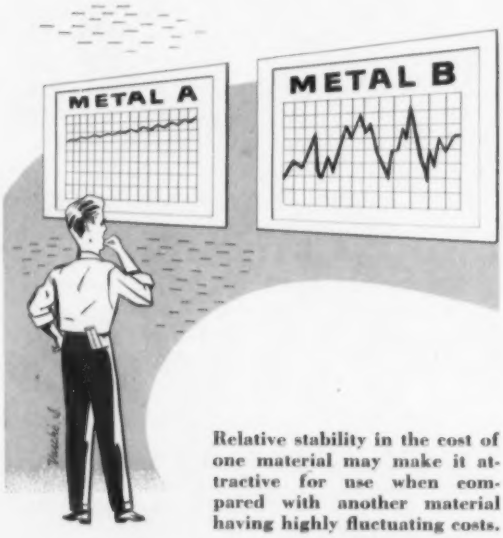
hours of operation compared with only 45 minutes before pump leakage when using special ferrous and nonferrous alloys.

A product design committed to one material does not have to remain bound to that material. Periodic review should be made of the possibilities of using other materials. The substitution of metals by nonmetals such as ceramics, glass, rubber and plastics is as deserving of attention as the substitution of one metal for another. During World War II this fact was driven home by necessity born of materials shortages. Many "substitute" materials gave such good service that the original materials were not subsequently used, even when they became plentiful.

The cost of basic materials is always changing. Use of new materials which, if used today, would price a product out of the market, may in a few years become entirely feasible from a cost standpoint. The downward trend in cost of some materials, such as plastics, relative to a material in use may dictate a change. In other cases, the relative stability of the cost of one material, such as aluminum may make it become attractive for use when compared with materials presently used that have highly fluctuating costs. Considering aluminum again, good machinability, and technological advances in welding and plating the metal, could make it attractive for use even before per-pound equality with a presently used material is reached.

Handling Costs

Handling of materials is an important factor in materials costs and may well influence selection. This is especially true when value has been added to a material and it then becomes the basic material for the start of other operations. To illustrate this point, a manufacturing plant needed large quantities of tie rods of a simple configuration as a material for further processing. Competitive bids were submitted, and the order was placed with the lowest bidder. Shipment of the material was made in bulk by truck trailer. On arrival at the plant, the material was unloaded by hand into containers suitable for transportation by fork truck to inventory and to the point of processing. Analysis of the cost of this material or product delivered to the job site showed that the lowest bid on the basic material was not the most economical. It proved to be most economical from a total cost standpoint to have the supplier ship the materials in palletized containers that could be removed directly from the trailer by fork truck. Although palletizing is more costly than



Relative stability in the cost of one material may make it attractive for use when compared with another material having highly fluctuating costs.

loading products in bulk and added weight may increase freight charges, the great savings in unloading time and handling in the receiving plant in many cases results in substantial savings.

The first opportunity to exercise control over the cost of materials occurs when they enter a plant. Although the points of control seem obvious, it is well to set up periodic checks to assure that no laxity occurs in guarding against losses. Improper handling of materials on their way to storage or inadequate provision for their protection after being placed in storage can result in damage that will make them unsuitable for processing. Denting, bending, or corrosion may be the cause of wasted materials at this early stage. In storage, careless or improper identification of stock can be the cause of rejected materials after they have reached the processing stage. Considering processed material at the end of one stage of production as the material for the beginning of the next stage, it is obvious that the farther materials have progressed in processing, the greater is the cost of losses. Attention to the areas of equipment maintenance and personnel training can also help to control these losses where value has been added by processing.

Inventory Control

Records of products and materials on hand, their use and orders for resupply constitute bases for inventory control. Losses can occur through oversupply and undersupply and, of course, it is important to guard against both. Losses chargeable to oversupply result from the high investment involved in storage, handling and record keeping costs, from possible deterioration, breakage or obsolescence, and from losses in value if prices decline. Costs of carrying an inventory are usually given as at least 10 percent of inventory value per year and in some cases as high as 25 percent. Undersupply can result in lost sales, failure to meet delivery dates, and premium payments for labor overtime, expensive small lot material orders, and special freight rates for rush shipments.

Recently, the manager of a midwestern plant pointed out how serious an inventory problem can become. After taking over the management of the plant, this manager discovered that the plant inventory had been allowed to reach the point where it was equivalent to about 80 percent of the annual gross sales. The large inventory proved to be the major source of losses suffered by the plant. This was an unusual case, but it does point up what can and does happen if controls are not exercised.

The importance of inventory on the cost of materials used in manufacturing has been emphasized by metal-fabricating-plant case studies*, which place average carrying charges at around $20 per year per $100 worth of material purchased. Recognizing that an inventory is necessary, costs such as these indicate that a definite effort should be made to make sure that optimum inventory is

*Bennett, K. W., Iron Age, 180, 83-85 (September 12, 1957).

Table 2—Comparisons of Cost Factors in Three Types of Forging

Factors Affecting Cost	Relative Cost		
	Drop Forging	Press Forging	Upset Forging
Raw materials	Low to moderate. Includes inexpensive steels up to more costly ferrous and nonferrous alloys	Average higher than drop forging because more nonferrous materials used, otherwise the same	Same as for drop forgings
Die	Relatively high. From several hundred dollars for simple dies up to thousands of dollars for more complex dies	Generally somewhat less than drop-forging dies	High. Multistep dies usually required
Optimum lot size	High. Lots of from 10,000 to 100,000 pieces and up are desirable.	Medium to high. Lower than drop forgings because of lower die and labor costs	High but less than for drop forgings
Labor	Medium labor costs. Skilled labor needed for heating, hammer working, and finishing	Lower than for drop forgings. Less skilled labor required	Low. Fewer skilled workmen required
Finishing	Medium. Requires machining and finishing. Ferrous alloy finishing costs higher than nonferrous because of greater scaling	Same as drop forgings	Low. Very little flash, thus saving in trimming costs
Scrap losses	Medium. Flash and machining losses, with flash loss greater on complex forgings	Less than drop forgings mainly because used on less complex shapes.	Low. Little or no flash to be trimmed

maintained to assure the lowest possible materials cost. Use of automatic data-handling equipment for inventory control or, at the very least, research to investigate this possibility, is often justified.

Fabrication Methods

Methods used in fabricating the part or component specified have an influence on its cost; types and quantities of basic material used, and the amounts of scrap generated are examples of cost elements that can be affected by methods of fabrication. Choice of fabrication method is closely tied to design, to material, and to facilities that are available and well understood by plant personnel. The latter influence probably plays a greater role than it should because of reluctance on the part of most people to change their ways of doing things. In the final analysis, cost will probably be the dominating factor in deciding between different methods of producing parts. The three most widely used methods of fabricating metal parts are forging, casting and machining.

Forging: There are three basic types of forgings, all three of which give comparable results so far as qualities of the end product are concerned. These are drop forging, press forging and upsetting or machine forging. TABLE 2 summarizes the major cost factors when considering forging as the method

Separate storage bins should be provided for each type of scrap. In this way, contamination is avoided and scrap has higher value.

of fabrication. A word of caution is appropriate when generalizing on fabrication methods in this fashion; there are many other details associated with specific products and manufacturing plants to be considered. Nevertheless the table does show that even among basic forging methods there are certain cost advantages to be realized by making the proper selection of method. From this general summary, upset-forging appears to have a slight over-all cost advantage over drop and press forging.

Casting: In terms of a material used in manufacturing, castings are generally thought of as one of the lowest-cost methods of producing parts. With respect to raw-materials costs sand casting is the lowest-cost process because the materials employed are used in their least expensive form. There are, however, a number of different methods of casting that vary considerably in the quality of product turned out and in the costs involved. TABLE 3 evaluates major cost factors in five casting processes. Of the casting processes described in the table, sand casting is the most widely used and the most versatile of all.

Machining: Fabrication of parts by machining is one of the most widely used methods in manufacturing. The screw machine is probably the most common class of chip removal tool, and it represents one of the most widely used methods of fabricating small parts. Furthermore, when parts are well suited to screw-machine fabrication, it provides by far the most economical method of shaping by chip removal. Reasons for this economy are:

Material costs are in the low medium range since commercial bar stock or tubing can usually be used
Tooling costs are nominal for the majority of jobs
Finishing costs are low
Unit labor costs are among the lowest; often one operator can attend several machines at once.

Other Methods: There are a number of other fabricating methods that are worthy of mention. Of these, one of the major methods is stamping. The main cost factors associated with stampings are the large unit quantities needed to justify use of the process, usually on the order of 10,000 pieces or more, and moderate to high die costs. While cost of finishing stampings is relatively low, scrap losses are often high. Other fabricating methods that are more specialized or less widely used for other reasons include: cold heading, impact extrusion, extrusion, powder metallurgy, spinning, electroforming, welding, brazing, adhesive bonding and plastics molding.

Scrap

The importance of scrap as a factor in material cost control cannot be overemphasized, regardless of the basic material being processed in a manufacturing plant. The sources that generate scrap, its handling and storage, and its ultimate disposal are deserving of careful consideration and control.

A certain amount of material becomes damaged or corroded while in storage. In addition to these losses from spoilage, there are materials losses that

Table 3—Comparison of Cost Factors in Five Metal Casting Processes

Factors Affecting Cost	Relative Cost				
	Sand Castings	Plaster Mold Castings	Permanent-Mold Castings	Die Castings	Investment Castings
Raw materials	Lowest of casting processes	Medium high because only nonferrous metals are cast	Medium. Chiefly nonferrous alloys	Medium high. Nonferrous metals only	High. Usually used with expensive alloys
Pattern	Low compared with cost of dies and tools	Higher than for sand casting			From $25 to about $2000, depending on complexity
Mold	Lowest of casting processes	Between sand and permanent	Much higher than sand casting. Highest except for die casting	Highest costs of any of casting processes	Low to moderate
Quantity requirements	No minimum; from few to few hundred	100 to 2000	Several thousand pieces generally considered minimum	Minimum of 500 units on simple parts	No minimum. 1000 units about maximum
Labor	High. Many hand operations	High. Skilled labor required	Lower than sand casting. Less direct labor and less cleanup labor	Low per unit piece because of high production rates	High. Many hand operations
Finishing	High due to cleaning and machining	Low. Less cleaning and less machining than sand casting	Lowest except for die castings	Low	Low
Scrap	Moderate. Scrap re-used at foundry	Low	Low	Lowest. All scrap is re-usable	Low. Usually no machining

must be expected in the normal course of production; ruined workpieces, flash from forgings, trimming from stampings, and borings and turnings from machine-shop operations are examples. Some such losses are inevitable, but they can and should be minimized. These sources of materials losses are closely related to product design, to selection of initial materials, and to process specifications.

Storage: Once scrap is generated, it becomes important to handle it systematically from its point of origin until final disposition is accomplished. Good procedure in handling scrap can prevent the mixture of ferrous and nonferrous scrap, keep to a minimum the amount of cutting compounds and lubricating oils mixed in with solid materials, and keep out contaminants such as wood, plastics and other materials. These contaminants reduce scrap values and might, in themselves, have scrap value if unmixed with other materials. When steps are taken to assure that scrap is properly handled at the points of origin and in removal from these points, precautions should be taken to store these materials in such a manner that they can be identified readily. For example, separate storage bins or storage areas should be provided for steel, brass, copper, stainless steel, and wood. Where quantities of certain materials are large, it may be practical to keep records on metallurgical specifications or lot numbers from which the scrap originated. Exact identification can then be made at disposal.

Disposal: Having given every attention within economic reason to keeping scrap to a minimum, it is desirable to get the greatest return possible from this no-longer-usable material, thereby reducing the net material costs. In disposing of scrap generated within a plant, the care exercised in handling and storage should show economic justification. In other words, there are economic limits to the effort that can be expended on the handling, storage, and disposal of scrap. These limits will depend on the quantities and the make-up of the scrap. The steel industry has estimated the cost of segregating scrap in terms of man-hours and equipment necessary to remove harmful materials at $4.50 per ton of scrap handled.

Investigation of materials costs is generally well worth the effort. Some areas of control may not be as fruitful as others, but the combined net savings realized, once efficient systems are developed, justify a look at all phases. Often overlooked, materials costs offer new and profitable avenues to reduction of manufacturing costs.

FACE MILLING

power measurements guide tool selections

POWER CONSUMPTION in face milling operations is important in many applications when the design of tooling and specification of cutting conditions are involved. Relations between power consumption and chip thickness, chip width, width of cut, number of teeth, diameter of face mill, rake angle, cutting speed and wear of tool have been evaluated with an accurate torque-measuring device placed between the face mill and the spindle of a milling machine. All experiments were carried out without cutting fluid.

Determination of milling torques was made on the basis of the torque on an arbor driving an attached face mill. The torque dynamometer, *Fig.* 1, consists of two parts firmly mounted on the arbor and works on the same principle as the Schallbroch-Schaumann lathe-tool dynamometer. A coil is placed on the front part of the dynamometer and a core on the rear part. The instrument is automatically protected against overload, i.e., loading widens the air gap between the coil and core.

Face mills used in the tests are listed in TABLE 1 and analyses of metals face milled in the tests are shown in TABLE 2. Workpiece surfaces were premachined prior to these tests in order to assure specimen uniformity.

The power consumption in milling with a face mill can be expressed as:

$$P = C'F_1\ (\alpha_r,D,n,t,V,w,W) \quad \ldots\ldots (1)$$

where C' is a constant for the metal being machined. Further, the power consumption for steel and cast iron can be expressed as:

$$P = C''F_2(H) \quad \ldots\ldots (2)$$

where C'' is a constant dependent on the factors α_r,D,n,t,V,w, and W.

Abstracted from Paper 194, "Power Measurements in Milling," to be presented at the 27th ASTE Annual Meeting. Copies of the complete paper will be available for purchase from Society Headquarters.

The moment on the arbor is equal to the sum of cutting forces acting on individual teeth multiplied by a constant. In a discussion of the influence of α_r,H,t,V, and W, it is possible to compare the dependence of the moment in milling with the dependence of the cutting force in other machining methods such as turning and planing.

Chip Thickness: The maximum chip thickness in face milling is related to the feed per tooth as follows:

$$t = f \cos \gamma \quad \ldots\ldots (3)$$

The cutting force or the proportional moment can be expressed in terms of chip thickness as:

$$M = Kt^{1-\eta} \quad \ldots\ldots (4)$$

In *Fig.* 2 the moment for two different metals is plotted on rectangular coordinates as a function of the chip thickness.

Behavior of the exponent η with respect to various conditions may be summarized as:

1. METAL MACHINED: For a number of metals the moment is plotted on logarithmic coordinates as a function of chip thickness, *Fig.* 3. An essential difference in η is observed for different metals. In general, the value of η is lower for the more difficult-to-machine metals.
2. CHIP THICKNESS: The value of η shows no tendency to vary with chip thickness over a range from about 0.001 to 0.030 inch.
3. TOOL: Tool material (sintered carbide or high-speed steel) and rake angle exhibit no influence on η. Independence of η from rake angle has been noted by other authors.
4. WIDTH OF CHIP CUT: For plain carbon steel, alloyed steel and cast-iron η, depth of cut—and thus also chip width—and width of cut appear to have little influence on η.
5. CUTTING SPEED: Variation of η with change in cutting speed is depicted in *Fig.* 4 for steel and cast iron. As cutting speed is increased from about 35

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Power consumption in milling depends primarily on workpiece material and tool wear. Tests have determined factors for calculating a job and are useful in selecting the best tooling and process specifications for milling.

Nomenclature

D = Diameter of face mill, in.
d = Depth of cut, in.
$F(-)$ = Function of (—)
f = Feed per tooth in face milling, in.
H = Brinell hardness number, Bhn
K, C, etc. = Constants
M = Moment on the milling arbor, lb-in.
n = Number of teeth in cutter
P = Power consumption at the cutter, hp
t = Chip thickness (equal to f in face milling with a corner angle of 0°), in.
V = Cutting speed, fpm
W = Width of cut, in.
w = Chip width (equal to d in face milling with a corner angle of 0°), in.

α_v = Rake angle measured from a normal to the finished surface in a plane containing the cutting-velocity vector, deg
β = Exponent in the equation $P = CV^{1-\beta}$
γ = Corner angle, deg
δ = Air gap, in.
η = Exponent in the equation $P = Kt^{1-\eta}$
ν = Exponent in the equation $P = kH^{\nu}$

to 500 fpm, the value of η becomes more negative by about 10 percent.

6. Tool Wear: Essentially η for a sharp tool is different than for a worn tool. As can be seen in *Fig.* 5, tool wear causes a greater percentage increase in cutting moment with small chip thicknesses than with larger chip thicknesses. For a very sharp tool, η is —0.22 for molybdenum steel and —0.17 for cast iron. For a slightly worn tool, η is respectively —0.28 and —0.31. In *Fig.* 6, η and flank wear of the tool are plotted as functions of tooth travel. It can be seen that η changes from —0.16 to —0.29 due to tool wear and that an average, or more representative, value of —0.255 corresponds to a slightly worn tool having a flank wear of about 0.006 inch.

The greatest change encountered in η due to tool wear was from a value of —0.15 for a sharp tool to —0.45 for the same tool with 0.030-in. wear.

Typical values of η with slightly worn tools (about 0.006-in. flank wear) at cutting speeds from 35 to 70 fpm are listed in Table 2.

It is possible to simplify the expression of milling power, without great error for usual shop practice, as follows:

$$P = Kt^{1-\eta} \quad \ldots\ldots (5)$$

where η is treated as independent of the tool material, chip thickness, chip width, width of cut, diameter of face mill and the relatively small variations in rake angle existing in commercial milling cutters, but dependent on workpiece materials, tool wear and, to a slight extent, cutting speed.

Chip Width: For the chip width the following relation is valid:

$$w = \frac{d}{\cos \gamma} \quad \ldots\ldots (6)$$

In *Fig.* 7 the moment is shown to be proportional

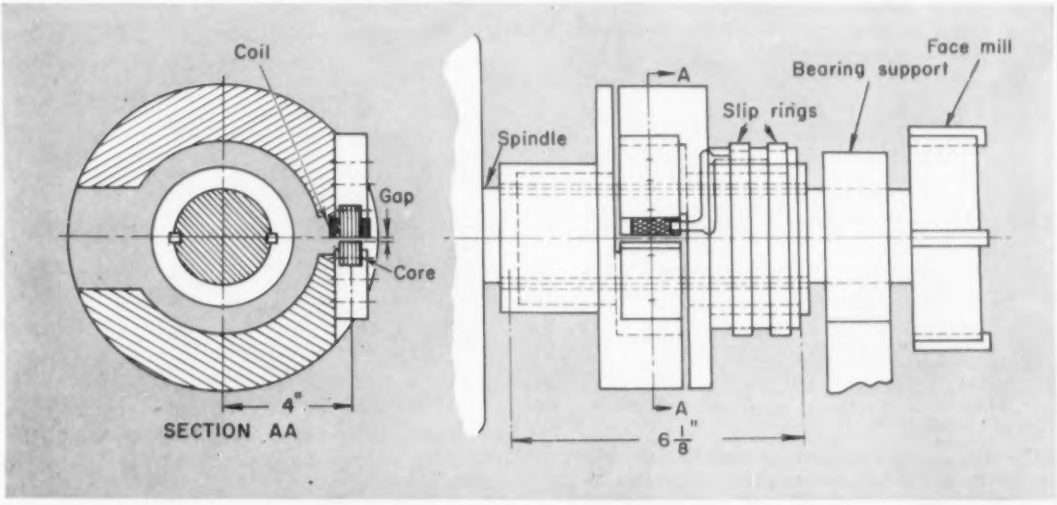


Fig. 1. Torque dynamometer showing use of coil and core to measure torque by variations in air gap.

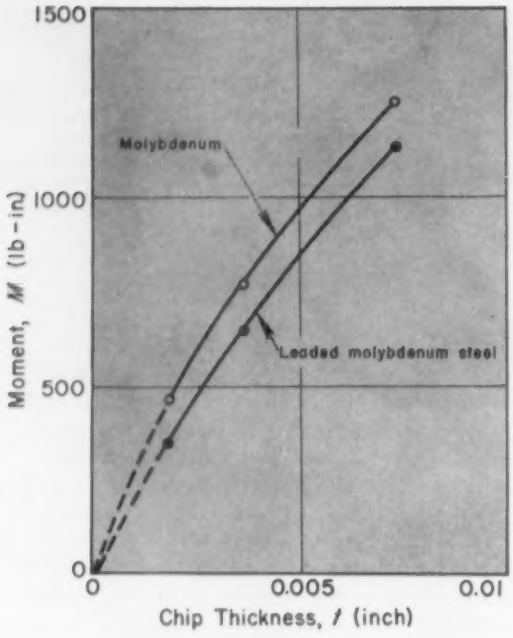


Fig. 2. Moment vs. chip thickness for face mill No. 5; width of cut, 3.65 in.; depth of cut, 0.0532 in.; cutting speed, 40.3 fpm for molybdenum steel and leaded molybdenum steel.

to the chip width. Thus the power consumption can be written:

$$P = K_1 W \quad \ldots\ldots (7)$$

Cutting Speed: The moment as a function of cutting speed is shown in *Fig.* 4. A decrease with increasing cutting speed can be seen and this decrease appears to be more pronounced with the greater chip thickness. Further decrease of the moment beyond 500-fpm cutting speed, however, should not be anticipated from *Fig.* 4.

For practical use the following expression is recommended:

$$P = CV^{1+\beta} \quad \ldots\ldots (8)$$

Values of β for a chip thickness of 0.008 inch are —0.12 for plain-carbon steel and —0.06 for soft

Table 1—Face Mills Used in Tests

Tool No.	Tool Material	Cutter Diam (in.)	Number of Teeth	Axial Rake (deg)	Radial Rake (deg)	Corner Angle (deg)	End Cutting Edge Angle (deg)	Peripheral Clearance (Primary) (deg)	End Clearance (Primary) (deg)
1	HSS	1½	8	+20	+6	0	1	6	6
2	HSS	2	8	+20	+7	0	1	6	6
3	Carbide	5	4	—10	—8	25	3	3	4
4	Carbide	5	4	—3	+2	25	3	3	4
5	HSS	5⅞	12	+6	+6	0	3	6	6

Table 2—Typical Values of Exponent η

No.	Description	Analysis (percent) C	Si	Mn	P	S	Cr	Ni	Mo	Pb	Hardness (Bhn)	Exponent* η
1.	Plain carbon steel	0.30	0.32	0.66	0.03	0.039					160	—0.195
2.	Plain carbon steel	0.22	0.11	0.85	0.03	0.043					146	—0.18
3.	Plain carbon steel	0.29	0.26	0.54	0.02	0.05					149	—0.28
4.	Plain carbon steel	0.25	0.18	0.47	0.04	0.057					146	—0.21
5.	Plain carbon steel	0.53	0.35	0.44	0.07	0.02					217	—0.225
6.	Plain carbon steel	0.05	0.01	0.35	0.07	0.09					167	—0.245
7.	Plain carbon steel	0.04	0.01	0.33	0.04	0.03					150	—0.47
8.	Molybdenum steel	0.08	0.32	0.52	0.010	0.03			0.45		223	—0.28
9.	Leaded moly steel	0.08	0.32	0.52	0.018	0.03			0.45	0.19	229	—0.155
10.	Nickel-chrome steel	0.10	0.25	0.47	0.03	0.014	0.62	3.57			192	—0.47
11.	Moly-chrome-nickel steel	0.33	0.43	0.70	0.03	0.003	1.06	1.23	0.36		240	—0.38
12.	Moly-chrome-nickel steel	0.54	0.25	0.49	0.02	0.01	0.98	2.88	0.47		223	—0.36
13.	Cast Iron (soft)	3.16	2.81	0.56	0.63	0.09					152	—0.30
14.	Yellow brass, rolled	Zn = 37.7% Cu = 62.2%									121	—0.315
15.	Copper, rolled	Cu = 99.8%									100	—0.455

*0.008 in. chip thickness; cutting speed 35-70 fpm; slightly worn tool.

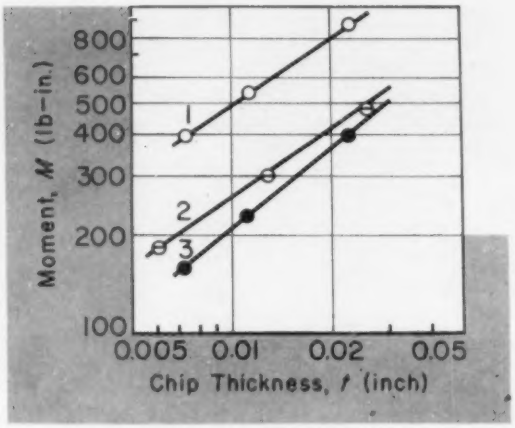


Fig. 3. (above) Moment vs. chip thickness. Curve 1: face mill No. 3; width of cut, 3.34 in.; depth of cut, 0.0394 in.; cutting speed, 394 fpm; metal No. 8. Curve 2: face mill No. 3; width of cut, 3.34 in.; depth of cut, 0.0394 in.; cutting speed, 34.4 fpm; metal No. 13. Curve 3: face mill No. 3; width of cut, 3.34 in.; depth of cut, 0.0197; cutting speed 394 fpm; metal No. 9.

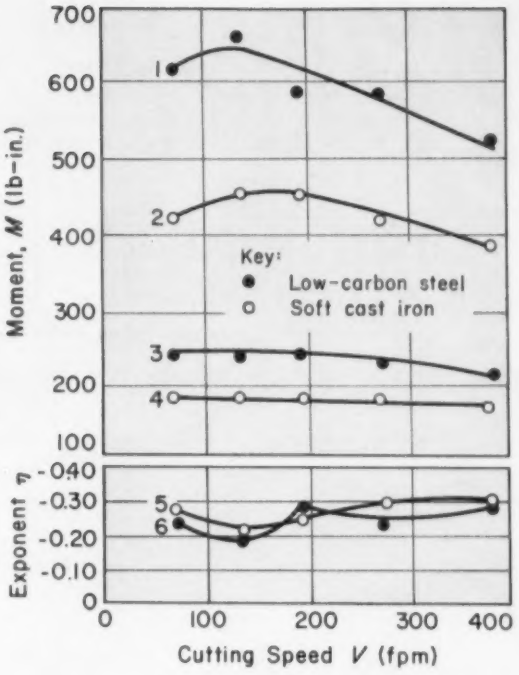


Fig. 4. (upper right) Milling moment and exponent η plotted against cutting speed for low-carbon steel and soft cast iron. Face mill No. 3; depth of cut, 0.0394 in. Curve 1: chip thickness, 0.0178 in. Curve 2: chip thickness, 0.0214 in. Curve 3: chip thickness, 0.00536 in. Curve 4: chip thickness, 0.00713 in. Moment is lower at high speeds.

cast iron over a cutting speed range from 35 to 500 fpm. For a chip thickness of 0.004 inch, β is slightly greater and for a chip thickness of 0.016 inch, slightly smaller, but this variation may be ignored in practical cases.

Cutter: As is shown in TABLE 3, the power consumption is proportional to n, W and inversely proportional to D. This is to be expected ($n = 6$ and $n = 3$ were obtained on face mill No. 5 by removing 6 and 9 teeth, respectively). This relationship is:

$$P = K_s \frac{n\ W}{D} \qquad (9)$$

Rake Angle: Power consumption can be expressed as a function of the rake angle α_v:

$$P = K_s\ (1.07 - 0.014\alpha_v) \qquad (10)$$

which is valid for $-30° < \alpha_v < +30°$ and inclinations from 0° to 50°.

Tool Wear: This relation has been touched upon in the previous discussion concerning η (*Figs.* 5 and 6). From a very sharp tool to a slightly worn tool, there is an increase in power consumption of 25 to 30 percent with a chip thickness of 0.007 inch according to *Fig.* 5, while a similar increase with a chip thickness of 0.025 inch is 0 to 15 percent.

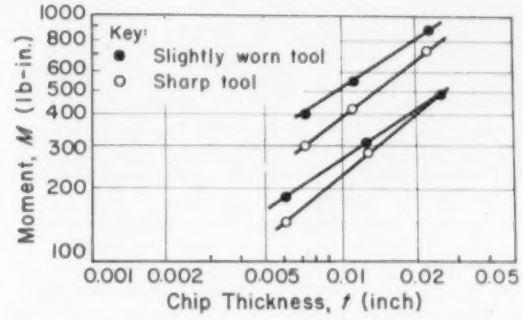


Fig. 5. Milling moment vs. chip thickness. Face mill No. 3; width of cut, 3.34 in.; depth of cut, 0.0394 in. Upper two curves: molybdenum steel, cutting speed, 394 fpm. Lower two curves: cast iron, cutting speed, 34.4 fpm. Sharpness affects power needed.

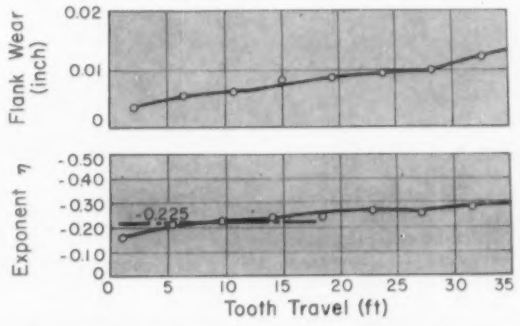


Fig. 6. Exponent η and flank wear vs. tooth travel. Face mill No. 3; width of cut, 3.05 in.; depth of cut, 0.0394 in.; chip thickness, 0.0036 -0.0224 in.; cutting speed, 394 fpm; plain carbon steel.

Table 3—Power Consumption for Typical Cuts*

Face Mill No.	Cutting Speed (fpm)	Number of Teeth, (n)	Width of Cut, W, (in.)	Moment, M (lb-in.)	Spindle (hp)	Workpiece Material (No.)	Factor nW/D
5	40.3	12	3.65	962	0.410	8	7.62
5	40.3	12	2.04	534	0.227	8	4.28
5	40.3	12	4.04	477	0.203	13	8.42
5	40.3	6	4.04	226	0.0958	13	4.21
5	40.3	3	4.04	117	0.0498	13	2.10
5	56.5	12	1.18	262	0.156	9	2.46
2	54.8	8	1.18	169	0.285	9	4.80

*Chip thickness, 0.00788 in.; depth of cut, 0.0394 in.

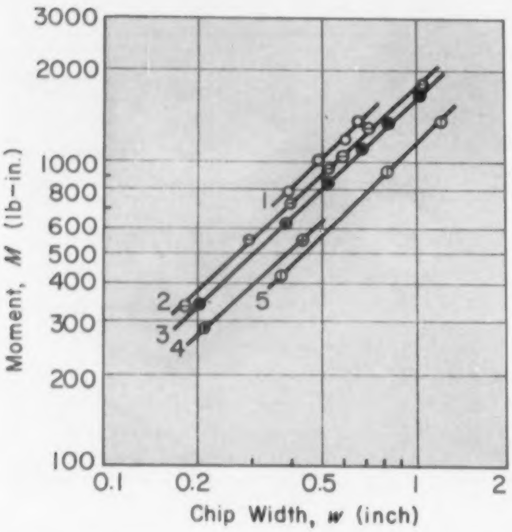


Fig. 7. Moment vs. chip width. Curve 1: face mill No. 5; width of cut, 3.70 in.; feed per tooth, 0.00736; cutting speed, 40.3 fpm; metal No. 4. Curve 2: face mill No. 5; width of cut, 3.65 in.; feed per tooth, 0.00524 in.; cutting speed, 40-55 fpm; metal No. 8. Curve 3: face mill No. 5; width of cut, 3.65 in.; feed per tooth, 0.00524 in.; cutting speed 40-55 fpm; metal No. 9. Curve 4: face mill No. 3; width of cut, 3.34 in.; feed per tooth, 0.0122 in.; cutting speed, 394 fpm; metal No. 8. Curve 5: face mill No. 5; width of cut, 5.68 in.; feed per tooth, 0.00366 in.; cutting speed, 40.3 fpm; metal No. 13.

Hardness: It is well known that the power consumption often is expressed as an exponential function of hardness, i.e., as:

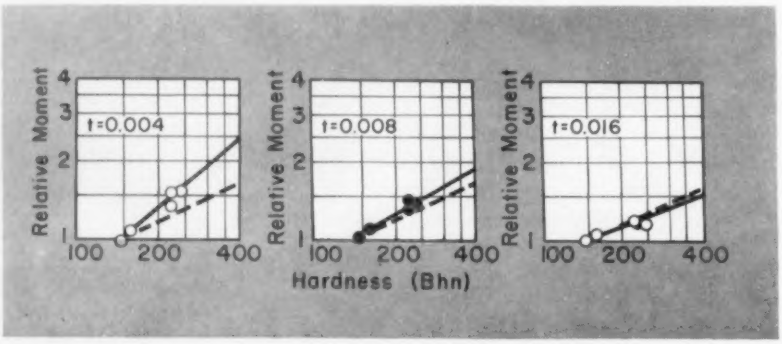
$$P = kH^{v} \qquad \text{(11)}$$

where v for the steel group is 0.50 and for the cast-iron group, 0.40.

The results of experiments with metals 1, 4, 8, 11 and 12 are plotted in *Fig.* 8. The moment for metal 4, 146 Bhn, is taken as unity for a basis of comparison. The dashed lines represent the curves if v were 0.50. For a chip thickness of 0.004 inch v is 0.87, for a chip thickness of 0.008 inch v is 0.60, and for a chip thickness of 0.016 inch v is 0.42. The value of v appears to be dependent on chip thickness.

Conclusions: The value of the exponent, η, in the relation between power consumption and chip thickness, depends primarily on the workpiece material and the degree of tool wear and to some extent on cutting speed, but is practically independent of other machining conditions. Power consumption is proportional to chip width, width of cut, and number of teeth and inversely proportional to diameter of face mill. The relation of power consumption to cutting speed and workpiece hardness is influenced by the chip thickness.

Fig. 8. Relative moment vs. workpiece hardness, Bhn. Metal No. 4 is taken as unity. Face mill Nos. 2 and 5; depth of cut, 0.0394 in.; cutting speed, 55 fpm; metals Nos. 1, 4, 8, 11 and 12. Curve 1: thickness 0.004 in. Curve 2: chip thickness, 0.008 in. Curve 3: chip thickness, 0.016 in. Dotted line, v = 0.50.



Silicone Rubber Molds
for accurate model reproductions

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Good reproduction of fine detail is characteristic of molds made from silicone rubber. The material vulcanizes at room temperature and is used for the manufacture of epoxy resin parts for consumer goods, tools and machines, as well as maintenance and repair parts.

Fig. 1. Encapsulation of low-production, subminiature electronic components. Molds, filled with epoxy resin, have a thin sheet of plastic film placed on the top of each to remove excess material.

LIQUID SILICONE RUBBER COMPOUNDS are a versatile mold material for plastic models. Room-temperature vulcanizing compounds combine the accuracy associated with rigid molds and the ease of handling of other flexible mold materials.

Advances in silicone technology have led to the development of these materials which cure at room temperature but retain the properties of conventional heat-curing silicone rubbers. Because of this special combination of characteristics, these compounds have been used for high-temperature sealing, caulking, potting and encapsulating agents in many industries. Recently, applications have extended into flexible mold materials, *Fig.* 1.

Applications for this low-cost, high-quality method of reproducing contours and shapes are being developed daily. Although there have been tremendous improvements in rigid-mold techniques, the need for a more reliable, higher quality mold material has persisted. Rigid molds are either expensive or limited in application. Since a one-piece rigid mold is suitable for producing only the simplest of parts, the majority of rigid molds are of the complex, multiple-piece type, incorporating knock-out pins. The fabrication of such molds is painstaking, time consuming and costly.

While conventional flexible mold materials reduce production time and expense, they do permit the duplication of parts with undercuts, recesses, embossing, and straight sides in a low-cost, one-piece mold. However, each of these materials, latex, plastisol, vinyl or polymercaptan rubber, has its

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***Senior member ASTE Schenectady chapter.**

Table 1—Typical Properties of Silicone Rubber

Property	RTV-20	RTV-60	RTV-90
Uncured:			
Color	Pink	Red	Red
Viscosity (cps)	30,000	70,000	1,200,000
Solids (percent)	100	100	100
Cured 144 Hours at Room Temperature:			
Specific gravity	1.30	1.45	1.45
Hardness (Shore A)	50	60	60
Tensile strength (psi)	450	650	750
Elongation (percent)	140	110	160
Tear strength (lb-in., Die B)	25	50	50
Linear shrinkage (percent)	0.2	0.2	0.2

Table 2—Typical Properties After Heat Aging

	RTV-20	RTV-60		RTV-90	
	24 hr 400 F	24 hr 400 F	40 hr 600 F	24 hr 400 F	40 hr 600 F
Hardness (Shore A)	50	65	75	55	65
Tensile strength (psi)	430	650	525	700	525
Elongation (percent)	140	110	70	150	100
Tear strength (lb-in., Die B)	25	35	40	50	35

disadvantages; excessive shrinkage, necessity of parting agent, poor surface reproduction, and high temperature cure.

Because RTV (room-temperature vulcanizing) silicone rubber does not have these disadvantages, epoxy models can be cast easier and more accurately. This material overcomes many of the disadvantages of both rigid and conventional flexible mold materials and provides the following benefits:

1. Low shrinkage
2. Elimination of parting agent
3. Superior surface and fine detail
4. Selective variation in cure
5. Selective variation in viscosity
6. High-temperature resistance
7. Quantity model production from a single mold.

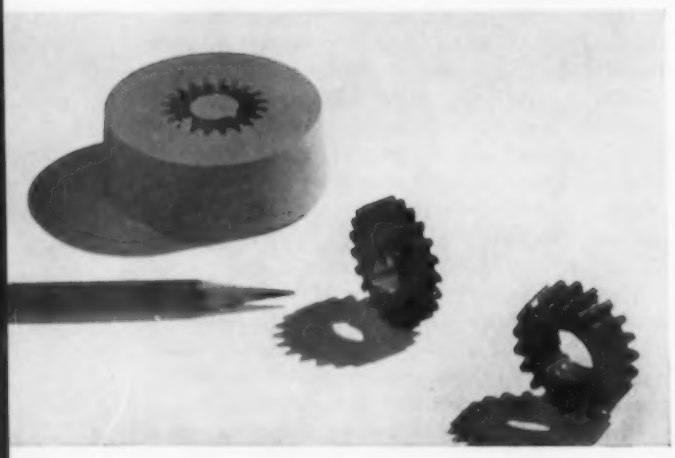


Fig. 2. Replacement helical gears are economically cast of filled-epoxy resin in silicone rubber molds. All machining, including finishing of the bore and keyway, has been eliminated. The mold is at the top of the picture, the broken part used for the model in the center and the finished part, as cast, at the right.

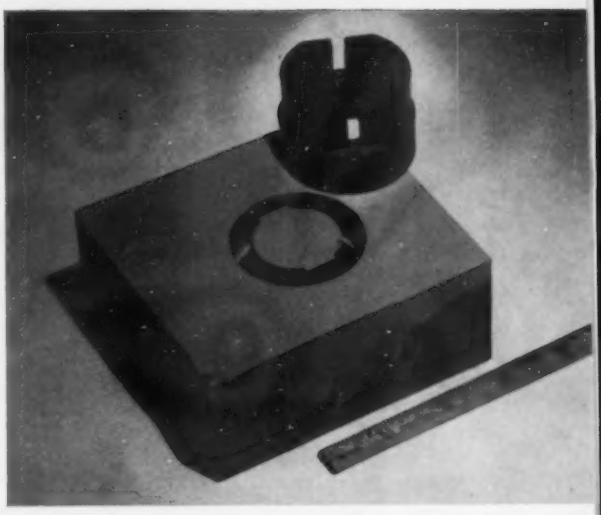


Fig. 3. A combination of soft and firm compounds has been used to fabricate this mold to facilitate removal of the intricate part.

The RTV compounds exhibit a combination of properties which make them particularly desirable as flexible mold materials. TABLE 1 shows the original and cured properties of three commercial grades of the material. When cured at room temperature, an excellent balance of properties is obtained, including sufficient strength to withstand multiple castings and the flexibility to permit removal of complicated parts. The low shrinkage is important in many close-tolerance applications.

In TABLE 2, it may be observed that there is essentially no change in properties after 24 hours at 400 F. Even after exposure to 600 F for 40 hours, the RTV compounds exhibit 60 to 80 percent of their original properties. It is this temperature resistance which enables these compounds to be used in heat-curing epoxy resins.

Of particular importance to those handling RTV compounds are the curing characteristics and the means by which the cure is controlled. After the addition of a curing agent, the compounds cure to a tough, flexible rubber product in a few hours.

Silicone rubber molds have been applied to the production of jet engine models. Twelve epoxy plastic nose cones were cast in the one mold made

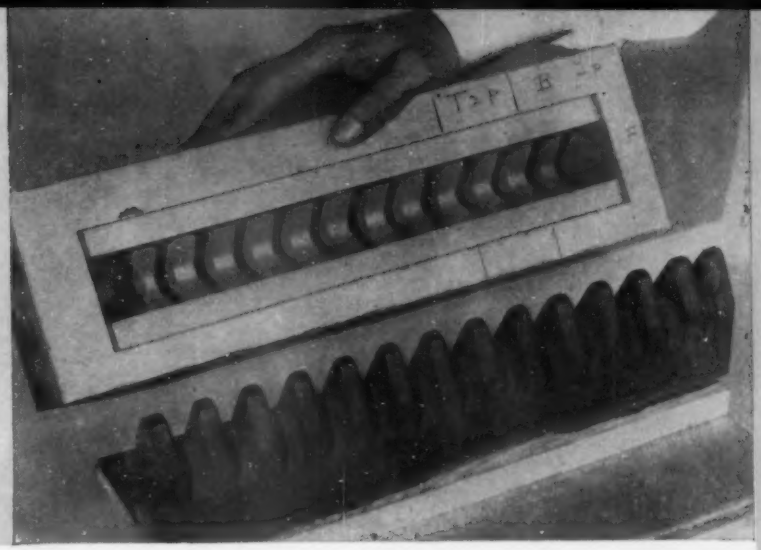


Fig. 4. Coil winding form made of a filled-epoxy resin cast in a flexible mold replaces one made of wood. The new part reduces the cost of manufacture and has an increased service life. The part is bonded on a wood base to reduce production costs.

from RTV-20. A glossy surface on the plastic cone indicates the ability of the silicone material to duplicate the polished finish on the aluminum model. The elimination of parting agents enables the plastic model to duplicate fine surface finish which is lost in most other flexible mold techniques. To be assured of a perfect surface on the epoxy model, it is essential that the mold surface be free of all air pockets and other imperfections. This is achieved by surface coating the master pattern with RTV liquid prior to pouring the mold. This surface preparation can be easily effected by carefully painting the material over the entire surface of the pattern with a small brush.

The ability of a mold to provide accurate model reproduction includes detail as well as surface quality. Just as RTV is painted on the master pattern, the epoxy resin is always painted over the entire mold surface before pouring the model. Maximum detail is obtained by this procedure which eliminates any possibility of air bubbles being entrapped on the surface of the model.

Parting agents, applied to the surface of some flexible mold materials, have a tendency to bridge across fine details and prevent accurate duplication by the cast epoxy method. The need for parting agents is eliminated because of the natural release ability of silicone rubber. In applications requiring a greater degree of detail than is normally obtained with RTV-20 or RTV-60, it is possible to improve the flow characteristics of these compounds and obtain sharper impressions by the addition of SF-69 silicone fluid.

Good dimensional stability of silicone molds make them extremely useful in repair and maintenance operations. Cracked or broken machine parts can be replaced with filled-epoxy parts cast in a mold made by using the broken parts as a master. Nonstandard machine parts can be cast inexpensively instead of roughing them out of metal or plastics. *Fig.* 2 shows a close-tolerance, nonstandard helical gear, which was cast complete in a rubber mold. As replacement parts for factory equipment, these gears were previously machined from a plastics laminate. Although no draft or clearances existed on any part of this gear, close-tolerance cast epoxy replacement gears can now be produced when necessary from this low-cost, one-piece mold.

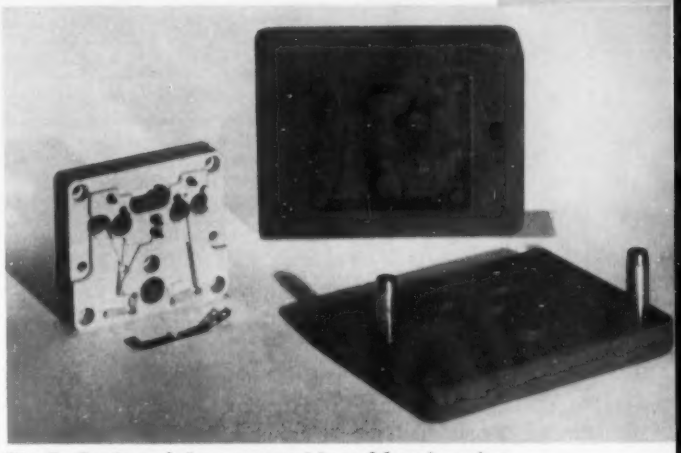


Fig 5. Casting of the exact position of locating pins in this assembly fixture eliminates the jig boring operation. Pins are set into the upper half of the molds and parts cast around them.

In many instances special machine parts, involving considerable machining, must be duplicated. It has been found practical and much less expensive to make a mold from the original pattern and cast the remainder with a filled epoxy resin. *Fig.* 3 shows one example involving the duplication of a machine part. Six of these parts are required for a special coil winding machine. The original pattern was machined from steel and produced with turned and bored diameters as well as flat milled surfaces and slots. Nothing was done to introduce draft angles or to obtain highly polished surfaces to aid in removing the parts from the mold. From

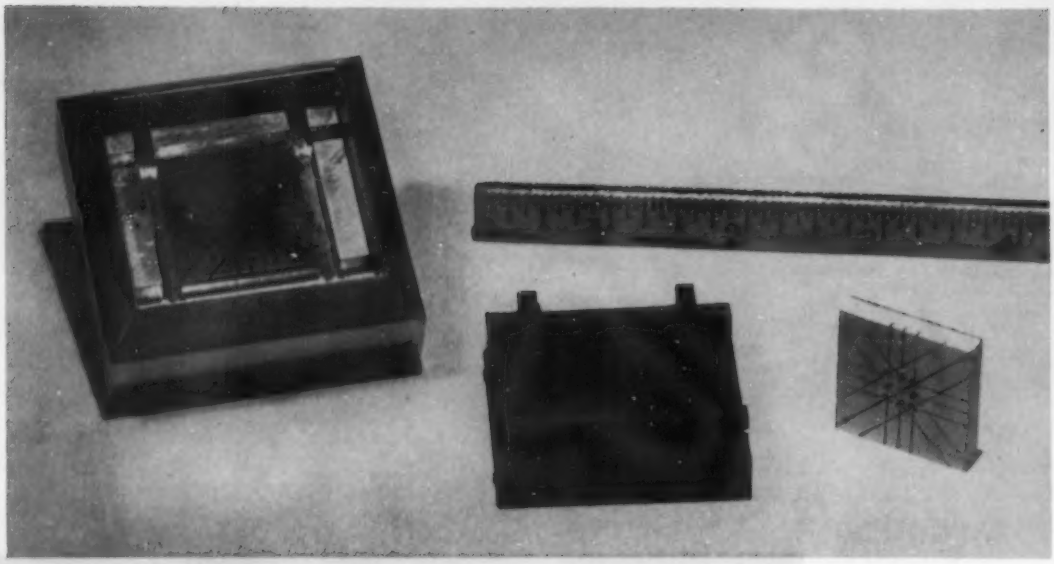


Fig. 6. Master pattern (left) was used to make the mold for the wire inserting fixture (right). Extreme precision was required in making the mold to assure complete filling of the grooves in the master pattern.

the original pattern, a silicone mold was made for casting the additional parts required. The inside surface of the mold was cast in soft RTV-20 for easy removal of the intricate parts. RTV-60, a more rigid material, was cast behind the RTV-20 to give the mold additional firmness. Sixty-five percent of the cost of machining the parts was saved by casting them from a filled epoxy resin.

Tooling is another area where the molds are beginning to play a significant role due to the tolerances obtainable and the ease with which complicated tools can be duplicated. Coil winding forms, *Fig.* 4, are now cast in a mold and bonded to a wooden base. Pairs of these units are used on coil winding machines. Originally, hard wood was used for the forms at a cost of $86 per pair when ordered in quantities of 25 pairs. Plastic forms, cast in flexible molds, are produced at a total cost of only $16 per pair. The complete silicone rubber mold was made in less than two hours. In addition to reducing the over-all cost, delivery time on replacement forms was reduced from three weeks to two days. These plastic forms are also much more uniform and sturdy than those previously made from hard wood and the service life of each unit has been greatly increased.

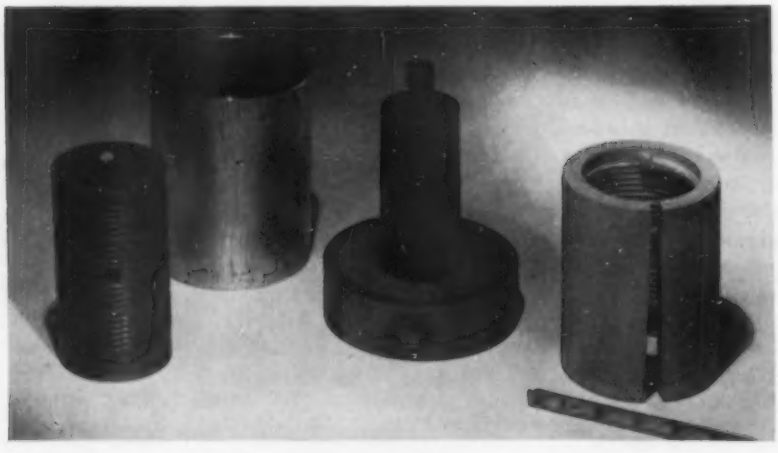


Fig. 7. Two-piece mold for reproducing the aluminum filled epoxy resin drum in the left foreground. The aluminum sleeve was used as a retainer for the split mold during the fabrication of the workpiece.

In *Fig.* 5, an epoxy-plastics conveyorized assembly fixture was designed to assemble motor switch components on an automatic machine. Fixtures were originally machined from laminated plastics. Holes were jig bored for locating pins since the center distance between the pins had to be held to 0.002 inch. These fixtures cost $175 each when ordered in quantities of 60. The new method uses a two-piece RTV-60 mold cast from a master pattern. A complete mold can be made for less than $50 and the parts cast with pin inserts for $10 each —a saving of over $150 per part.

Wire inserting fixtures, similar to the one shown in *Fig.* 6, are used in the manufacture of magnetic memory storage units. The RTV-60 silicone mold, made from an aluminum and brass master pattern, can normally supply as many cast epoxy tools as production may require. Manufacture of these fixtures demands precision and accuracy since the grooves for the wires are only 0.060 inch deep and 0.015 inch wide. In addition, small rectangular cavities at the junction of the wire crossing must accurately locate a miniature ferrite core. This fine detail was achieved by first coating the surface of the master pattern with the silicone liquid. An air blast was directed on the pattern to force the liquid rubber into each groove and cavity. The result was a mold that duplicated the original.

Ease of handling silicone rubber compounds combined with their flexibility, good dimensional stability and natural release ability make them desirable for casting small and fragile parts. Miniature epoxy jet-engine brackets were made in a split mold and a jet-engine cylinder and piston assembly were cast in a one-piece open end mold. Aluminum parts were used as the patterns to make these molds. Pins were located in the split mold to provide two cast holes through the brackets and a syringe was used to inject plastic into the small mold cavity.

It would be virtually impossible to remove a fragile, 0.030-inch thick epoxy casting of a four-inch actuator ring from a rigid type mold, even with an elaborate knockout pin system. Because of the difficulty in applying parting agent to the mold, it is doubtful if any of the earlier flexible mold materials could be used for this part. Breakage of the parts, tearing of the mold and build-up of parting agent in the mold would be major obstacles. Twenty epoxy duplicates of an actuator ring were produced in a flexible silicone rubber mold and no parting agent was needed.

The aluminum-filled cast epoxy drum, *Fig.* 7, is an example of the versatility of silicone mold materials. This part was cast in the two-piece mold with four cross holes extending through the wall of the drum. If a rigid mold material were used, it would be necessary to incorporate retractable cores for the cross holes. However, by applying silicone materials, cores were put in the outer mold.

One of the four cores which permitted the cross holes and adjacent slots to be cast in the epoxy part along with the grooves and other details is located on the top inside half of the mold. In addition to a reinforced plastic base and steel shaft, silicone rubber was also used as a core to produce the cavity of the drum. Aluminum tubing was used as a retainer when pouring the outer mold around the pattern. After curing, this flexible mold was removed from the tubing and cut through on one side to facilitate removal of the pattern as well as the subsequent cast parts.

The original drum cost $150 when machined from steel. In lots of ten, this cost was reduced to $75 each. However, the part shown in *Fig.* 7 was cast for $5 each. The only machining operation was to broach a keyway on the ID.

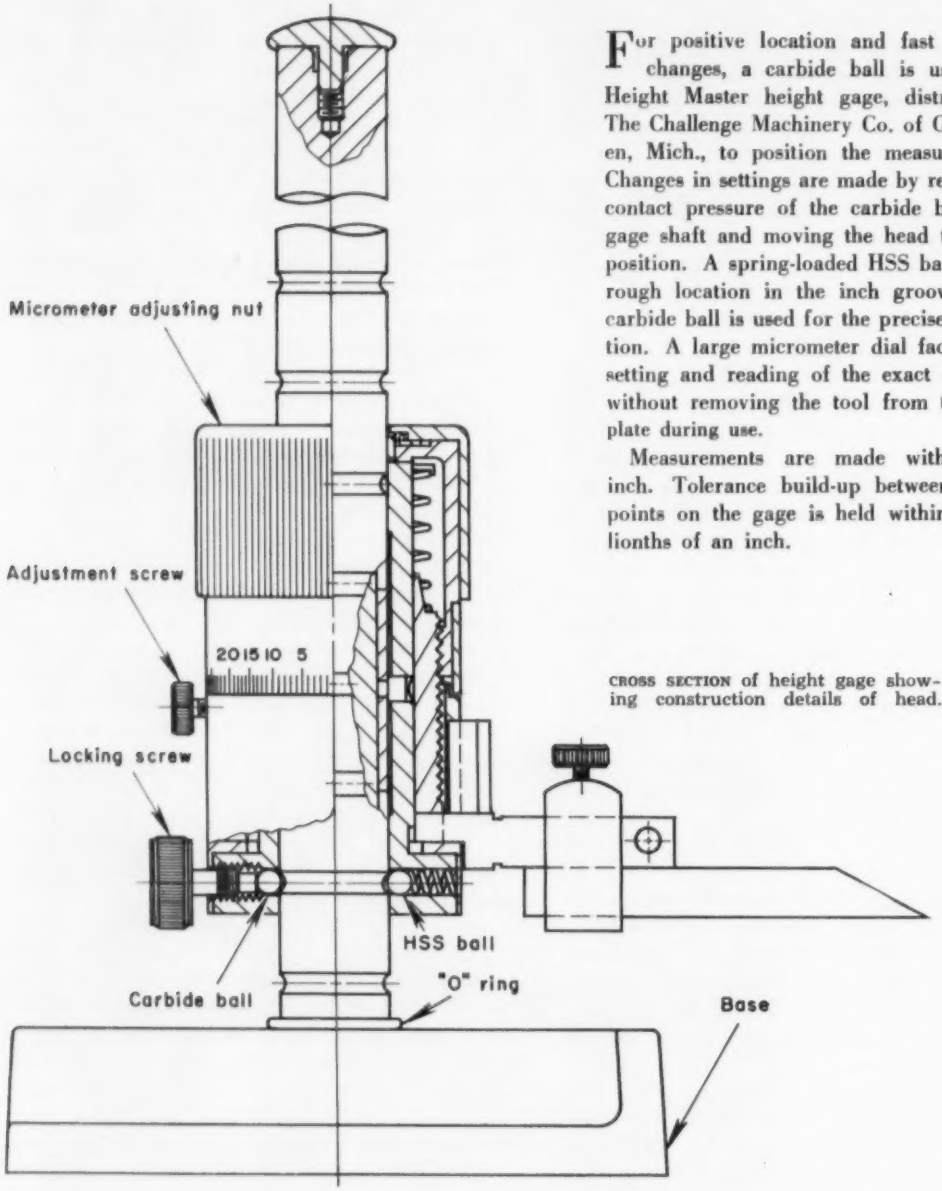
Another of the advantages of silicone rubber is its ability to withstand high temperatures which makes possible the curing of epoxy resins at elevated temperatures in flexible molds. One part is a transistor fixture made for a testing machine which uses twenty-five fixtures for each machine. This fixture, originally machined from nylon, contains 14 different milled slots or grooves. The savings realized by using the flexible-mold, cast epoxy method amounts to 60 percent.

The ability to produce a mold which can turn out several dozen parts is another important feature of this mold material. Toughness, flexibility, smooth surface and built-in release properties make these molds desirable for low-volume production of cast epoxy parts. *Fig.* 1 shows silicone molds that are being used to encapsulate low production, subminiature electronic components. Five molds shown before the worker have been filled with epoxy resin. A thin sheet of plastic film is placed over the top of each mold to remove the excess material. The molds are then placed on a tray in an inverted position and inserted into an oven for final cure. As many as 50 parts have been produced from a single mold without affecting the release ability of the mold or the surface appearance of the finished part. This item is cubical in shape and its sides have no draft or clearance angles to facilitate removal from the mold. By flexing the mold, the finished part is easily removed.

It is evident that silicone rubber is already making a significant contribution as a flexible mold material. Through its use, significant savings are being made in the casting of prototype models and replacement parts, in the encapsulating of epoxy parts, and in the manufacture of low-cost tools and fixtures. The ultimate benefits to those actually involved in model reproduction are higher quality models and a greater savings in the time and cost of producing parts.

designed for
PRODUCTION

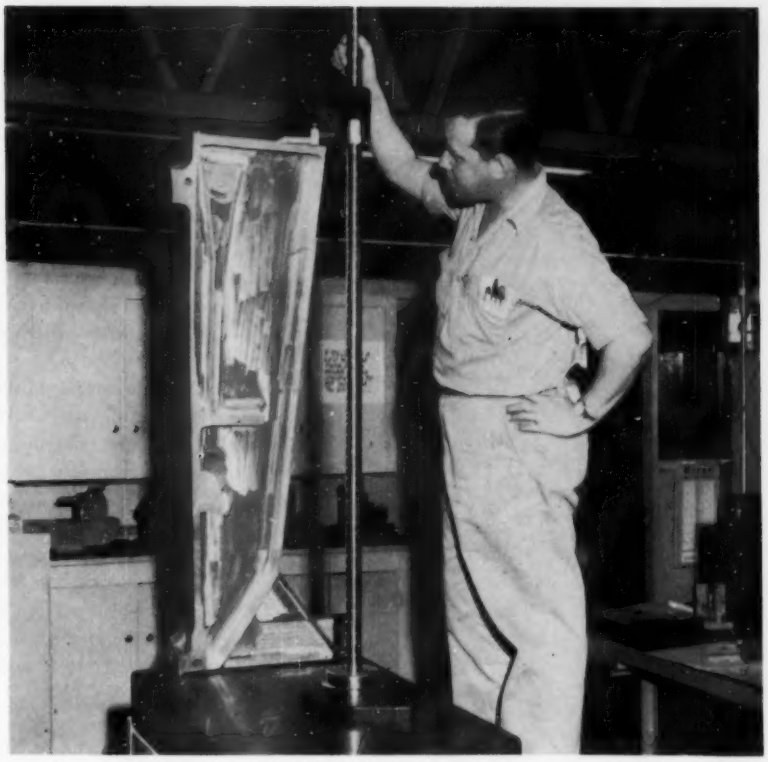
Height Gage Has Carbide-Ball Location



CROSS SECTION of height gage showing construction details of head.

For positive location and fast dimension changes, a carbide ball is used in the Height Master height gage, distributed by The Challenge Machinery Co. of Grand Haven, Mich., to position the measuring head. Changes in settings are made by reducing the contact pressure of the carbide ball on the gage shaft and moving the head to the new position. A spring-loaded HSS ball finds the rough location in the inch groove and the carbide ball is used for the precise inch position. A large micrometer dial facilitates the setting and reading of the exact dimensions without removing the tool from the surface plate during use.

Measurements are made within 0.0001 inch. Tolerance build-up between any two points on the gage is held within fifty millionths of an inch.

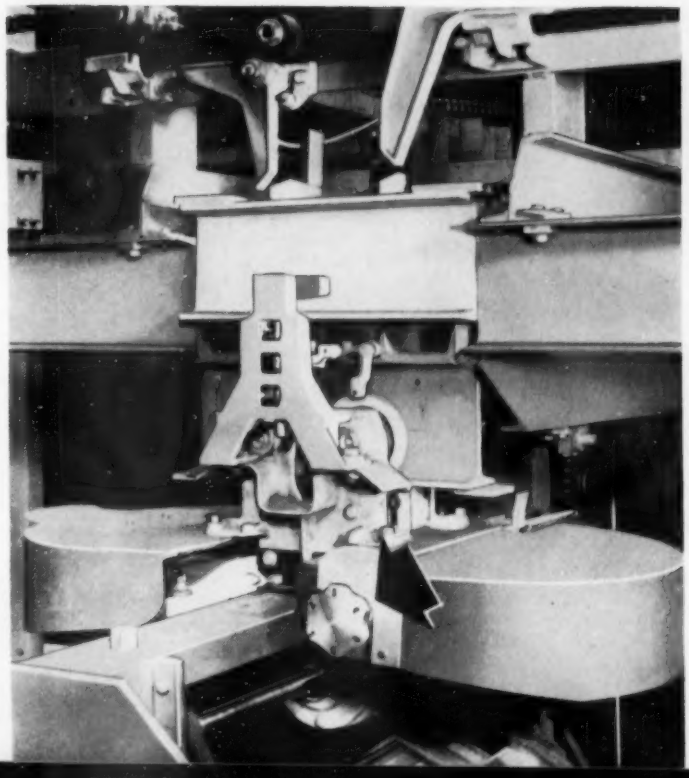


AIRCRAFT forging being checked with a seven-foot height gage after contour machining. The workpiece is positioned on the plate relative to the location surface for faster direct reading of dimensions on the gage.

Operator Preselects Processing Cycle for Plating

Selection of the proper processing cycle for a workpiece carrier has been facilitated by presetting a single dial on each carrier in a system developed by Abbey Process Automation, Inc. of Long Island, N. Y. In the illustration, a plating barrel is being handled through a processing cycle.

One operator can predetermine the course of all individual carriers in the system by setting the dial on each carrier to the proper number corresponding to the production or processing pattern desired. Cycles can also be altered during processing by remote resetting to new requirements by relocation of electromagnetic trippers.

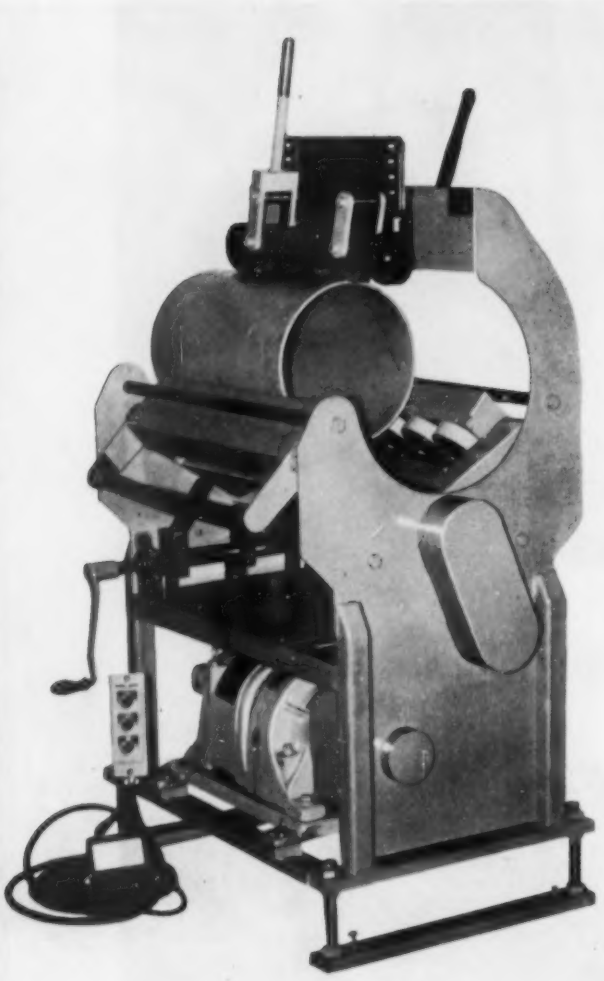


Puller for Extruding Plastic Pipe

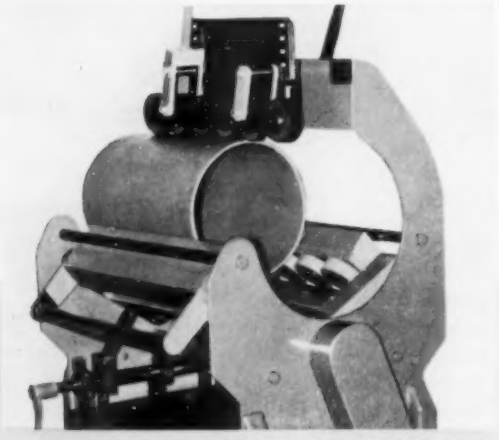
To maintain close tolerances in the manufacture of plastic extrusions, the workpiece must be pulled as well as pushed through an extruding die. To do this pulling, a side-loading pipe-puller has been developed by Al-Be Industries of Bell Gardens, Calif., for any size plastic pipe, tubing or rod from 1½ to 12 inch.

A single toggle lever opens the roller unit, permitting pipe to be loaded or removed through the open side. Three seats of neoprene covered rollers are spaced around the pipe at 120-deg intervals. Two sets of these rollers are used to pull the pipe anl third set exerts constant pressure on the driving rollers.

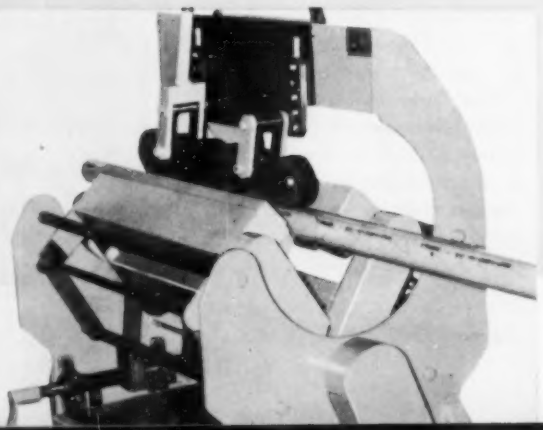
Extrusions can be processed through the unit at speeds ranging from 0.9 ipm to 20 fpm. Timing chains connected to variable speed motor drive the feed rollers to assure simultaneous operation.



MACHINE for pulling plastic extrusions from the die to maintain close tolerances on the workpiece. All operating components of the unit are mounted on a frame to facilitate movement to other work areas.



ADJUSTMENT of the unit for 12-inch pipe is made by turning the front crank.

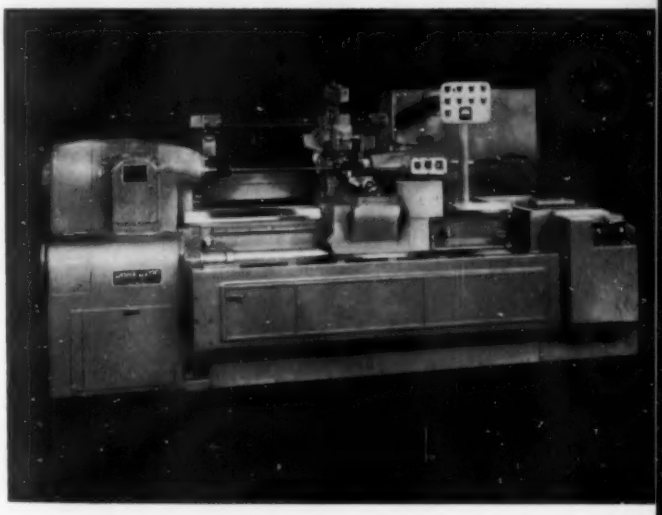


PIPE PULLER adjusted for 1½-inch pipe by pivoting the adjustable rollers to the proper location relative to the pipe center line.

Accuracy Improved with Tracer-Controlled Follow Rest

Turning long, slender workpieces such as rifle and shotgun barrels have been difficult due to the flexible nature of the part. To facilitate this machining, a tracer-controlled follow rest has been developed by Monarch Machine Tool Co. for use on the Mona-Matic lathe.

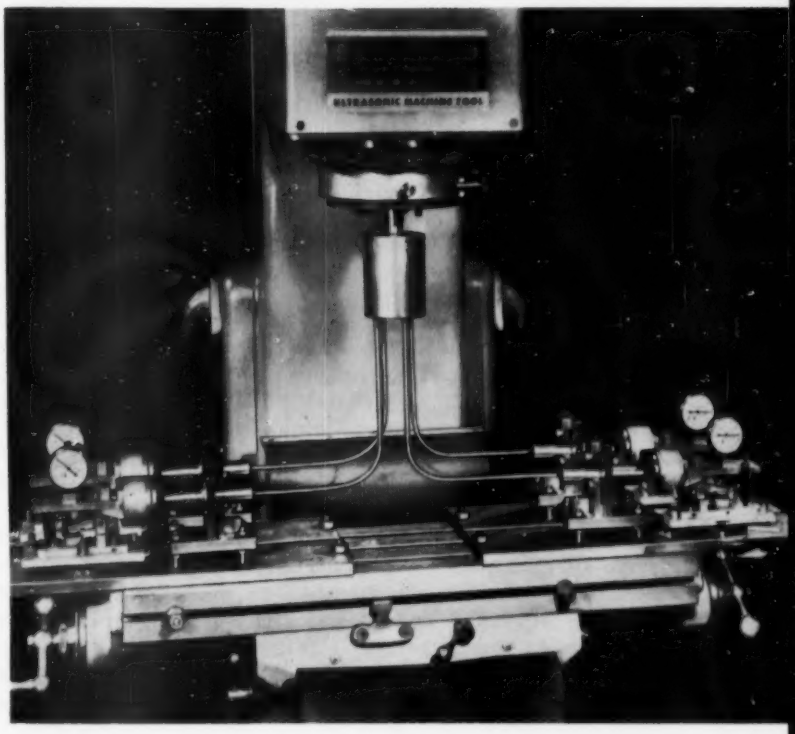
Antifriction follow rest rollers are mounted above and behind the workpiece. Each roller is moved in and out by a separate hydraulic cylinder controlled by its own air-gage tracer. A spring-loaded roller is mounted adjacent to and immediately following the tool. During turning, contouring is controlled by the feed tracer with the tracer slide set at 90 deg to the work. The template, in the form of a master workpiece, is traced by three heads. The front head controls the tool; the other two heads correspond in position to the follow rollers controlled during the machining operation.



Ultrasonic Machining with Extension Tooling

Four standard extension type tooling units mounted on the table of a Sheffield-Cavitron ultrasonic machine tool permit up to four machining operations to be performed simultaneously, or each station can be operated independently. Driven from the single transducer, the units can be mounted back-to-back, opposite, side-by-side, criss-cross or on top of each other. Each workpiece station has its own feeding device and feed indicator with 0.0001-inch increments to show the tool position.

High frequency mechanical oscillations from the transducer are transmitted by means of curved cylindrical rods to remote machining stations at any angle to the transducer. One rod or ultrasonic transmission line is needed for each station. A typical application is the machining and dicing of germanium, silicon, ceramic or ferrite crystals.



fabricating STAINLESS STEEL

part four—heat treating and finishing

By Richard E. Paret
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Strength and appearance of products made of stainless steel depend on how well the final operations—heat treating and finishing—are performed. This article, the last in a series covering all fabrication methods, describes best practices for these operations.

THE RANGE OF APPLICATIONS of the stainless steels is constantly being extended. Applications are determined in large part by three advantages of the metal: strength, durability and visual beauty. To realize each of these qualities to the utmost, special attention must be paid to heat-treating and finishing techniques, *Fig.* 1.

Heat Treatment

Heat-treating operations are intended to produce desired physical and mechanical properties. They can be divided into three classes of operations: annealing, hardening and tempering. Annealing, *Fig.* 2, relieves residual stresses and restores ductility for all grades after fabrication. It also restores maximum corrosion resistance to the austenitic grades, especially after welding. Hardening increases the strength and corrosion resistance of martensitic grades. Tempering improves the ductility and toughness of hardened steel.

Generally, heat-treating methods and equipment similar to those used for carbon steel are employed. Gas-fired, oil-fired and electrical resistance furnace types of conventional design are used. Usually such furnaces must be able at attain temperatures of 2100 F because of the high alloy content of stainless steel. With oil or gas-fired units, the flame must not impinge directly upon the work. Muffle type furnaces, are therefore, preferred to direct-fired types when heating stainless alloys.

Controlled atmospheres such as cracked dry ammonia gas or dry hydrogen provide scale-free treatment and also prevent carburization, which can impair corrosion resistance, especially of the austenitic grades. It is important to remove all oil or grease from workpieces before heat treating, since organic material may cause local carburizing. Adequate supports should also be provided for parts during heat treating to minimize distortion.

Molten salt baths and induction-heating methods are also used extensively with stainless steel and provide good results. Salt baths prevent carbon or nitrogen from contacting the work and prevent scale formation. Induction-heating equipment similar to that used for low-alloy steel can be used to anneal restricted areas to relieve work-hardening stresses between forming operations. Annealing of tips of stainless-steel cooking utensils after drawing and trimming and before final shaping and heading is an example.

Proper control of both temperature and time during heating and cooling cycles is a vital factor in heat treating. Subjecting certain grades of stainless steel to excessive soaking periods, even at the correct temperature, may result in the loss of desirable properties in the steel such as grain size.

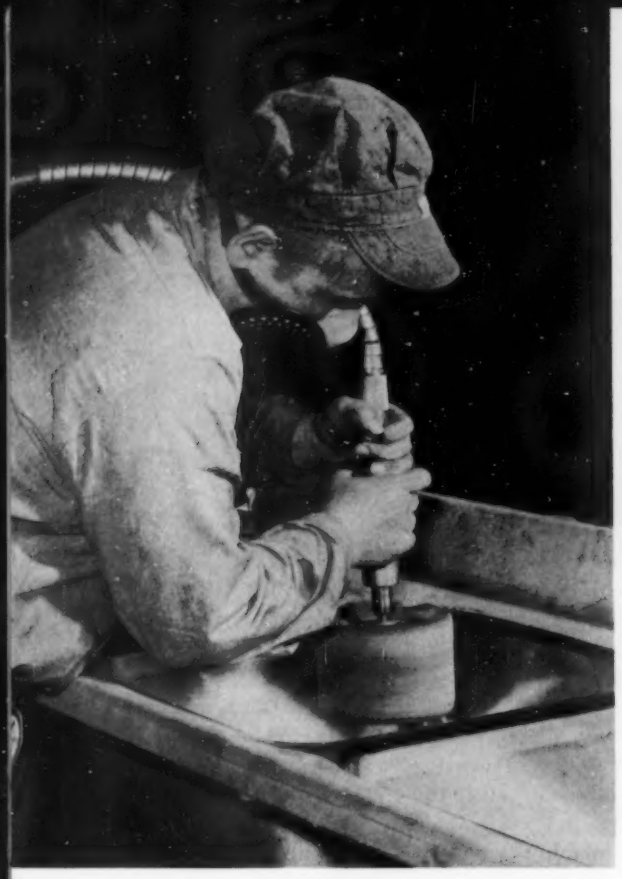


Fig. 2. Process annealing operation is required in the production of Type 302 stainless-steel cream separator supply cans. After the first drawing operation parts are annealed by heating to 2050 F, held at temperature for five minutes and cooled rapidly in air. A second drawing and hydraulic bulging operation follow.

Fig. 1. (left) Buffing the inside of a sink bowl, deep-drawn from Type 302 stainless steel.

Temperatures on the high side of the limits given should be used except where the steel has a very low carbon content. This is particularly important when parts have heavy sections. Parts must be thoroughly soaked at final temperature, *Fig.* 3, to assure uniform heating throughout the work-piece.

Austenitic Materials: These types cannot be hardened by heat treatment but certain grades, particularly Types 201 and 301, can be cold worked to produce high strength. Annealing after fabrication is not generally required. In some cases, where service might lead to possibilities of stress corrosion, stress relief annealing may be desirable. The elastic properties of some types in the austenitic group can be improved by stress relieving at temperatures from 400 F to 750 F, following fabrication. Yield strength and toughness of the steel are improved with no impairment to tensile strength or ductility. The danger of carbide precipitation is also avoided at these temperatures.

When high-carbon or unstabilized steels have been subjected to welding or treatment which might lead to carbide precipitation, and corrosive service conditions are expected, full annealing to redissolve precipitated chromium carbides is necessary. Intermediate anneals may be required to restore ductility to chromium-nickel steels during severe drawing operations. Generally, these are soaked for approximately 30 minutes for each inch of thickness. It is also advisable to preheat heavy sections to 1400-1500 F and then increase rapidly to final temperatures. Final annealing temperatures are shown in TABLE 1.

Rapid heating and cooling are essential with chromium-nickel alloys to avoid carbide precipitation while passing through the sensitizing range (800 to 1650 F). If precipitation occurs as a result of slow heating, a longer soak is required at the annealing temperature. Water quenching of ⅛ inch and heavier sections will speed up the cooling process but distortion can result.

Ferritic Materials: Ferritic steels are non-hardening, but are stress relieved at temperatures of 1250 to 1600 F to relieve internal stresses caused by cold working. Maximum ductility is attained by holding at the temperatures given in TABLE 2 for not less than one hour per inch of cross section. Exceeding these recommended temperatures may produce grain growth and brittleness in the steel. Parts should be cooled rapidly in air or water to improve impact properties. Air cooling of light sections will minimize distortion.

Martensitic Materials: All forms of heat treating—hardening, tempering and annealing—are used for these materials. High strength, toughness

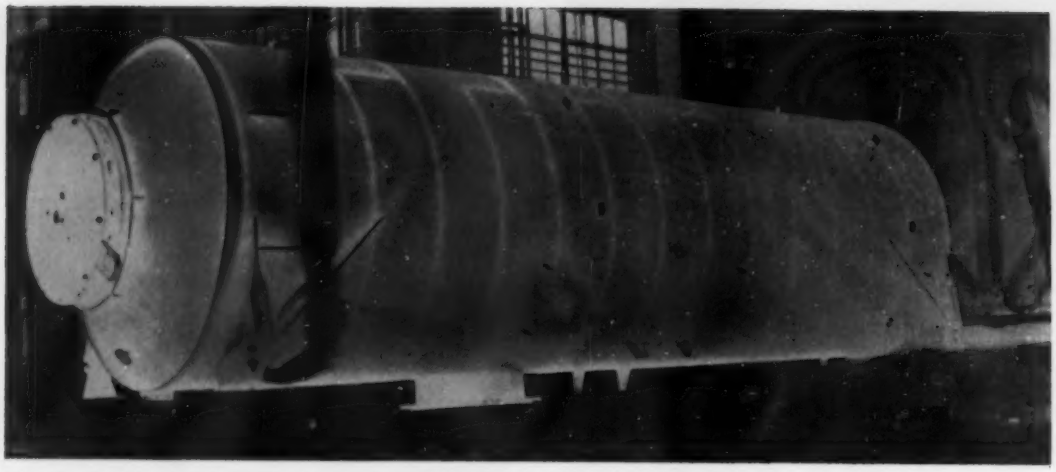


Fig. 3. Stainless-steel vessel after removal from a heat-treating furnace. Thorough soaking is required to assure uniform heating throughout the work.

and improved corrosion resistance can be developed in martensitic steels by heating to the temperatures shown in TABLE 3 and quenching in oil. Oil quenching produces a slightly higher yield strength and hardness than air cooling. Air cooling, however, is recommended for intricate shapes to prevent cracking. Martensitic steels have low-thermal conductivity and should be heated slowly to the proper temperatures. Types 420, 440A, 440B and 440C should be preheated slowly to 1450 F and allowed to soak for not less than one hour per inch of cross section before heating to final temperatures.

Tempering, especially for high-carbon types, should be done immediately after hardening to prevent cracks. Temperatures in the range of 300 to 800 F, followed by any convenient cooling method—air, oil or water—will produce maximum toughness after hardening. Temperatures in the 800 to 1200 F range will reduce both the corrosion resistance and impact strength of hardened martensitic steels and should be avoided.

Process annealing is carried out at temperatures of 1150 to 1400 F, depending on the grade of steel. Parts must be slow-cooled, preferably in a furnace, to prevent rehardening. Cooling rates of approximately 25 to 50 degrees F per hour to 1100 F will give best results. Air-cooled parts should not be heated above 1400 F. For full annealing, temperatures of 1500 to 1650 F—followed by slow cooling—are used. Table 4 is a summary of annealing temperatures for various grades of martensitic steel.

Finishing

Mechanical finishing by the fabricator is usually concerned with blending-in local areas affected by welding operations, with the original mill-polished finish on the rest of the part. Every precaution should be taken, however, to protect polished surfaces not altered by fabrication. Exercising a moderate amount of care during forming, punching, shearing and other operations will eliminate the time and trouble required to polish out surface marks incurred unnecessarily.

Adhesive paper or masking tape provides protection when handling or laying out work, *Fig.* 4. Sections can be removed with hot water, or peeled back where parts are to be joined. For light forming operations, rubber-base or plastic coatings are excellent safeguards for lustrous finishes. When specified, these peelable coatings can be sprayed or painted on the surface of the stock at the mill.

Table 1—Annealing Temperatures for Austenitic Stainless Steels

Material Type	Temperature* (deg F)
201, 202	1850-1950
301, 302, 303, 305, 308, 316, 347	1850-2050
309, 309S	1900-2050
310, 310S	1900-2100
314	2100
321	1750-1950

*Workpieces to be cooled rapidly from these temperatures.

Table 2—Annealing Temperatures for Ferritic Stainless Steels

Material Type	Temperature* (deg F)
405	1350-1500
430	1400-1500
430F, 430Se	1250-1400
446	1450-1600

*Workpieces to be cooled rapidly from these temperatures in air or water.

Fig. 4. Applying adhesive tape to stainless-steel sheet prior to blanking operation. Protective layer prevents marring of mill-polished finish.

Good shop practices to avoid marring include:

- Placing waxed paper or oiled paper between polished surfaces and dies to eliminate scratches
- Keeping dies well polished and honed to prevent metal pickup
- Using adhesive tape on working faces of dies for bending operations on hand brakes
- Covering hold-downs on press brakes with felt
- Using protective layers of cardboard on press beds
- Using hard alloy bronze pressure pads and adequate lubrication during drawing and rolling operations.

Latex or plastic base coatings, applied on blanks by dipping or spraying methods before drawing operations, will protect the surface of the workpiece and also act as lubricants.

Grinding and Polishing: When blending welds, it is generally best to grind or polish in the direction of the weld to prevent gouging on either side of the bead. With other polishing applications, however, changing the direction of cutting with each successive operation is helpful. This practice aids in detecting whether scratches and marks from the previous operation are removed. Embedded abrasive particles of iron oxide or other ferrous materials will rust and should never be used in finishing operations on stainless steel.

The low heat conductivity of all stainless steels requires that grinding wheels be dressed frequently and that fabric polishing wheels be well ventilated. Moderate pressure and long strokes prevent overheating when grinding, polishing or buffing. For grinding and polishing, rubber or resin-bonded wheels are preferred to vitrified wheels, which tend to load up quickly. Adequate coolant and a minimum of wheel pressure will prevent overheating and warpage. For finishing weld areas, a coarse

Table 3—Hardening Temperatures for Martensitic Stainless Steels

Material Type	Temperature* (deg F)
403, 410, 416, 416Se	1700-1850
414, 420	1800-1900
431	1800-1950
440A, 440B, 440C	1850-1950

*Workpieces to be quenched in oil from these temperatures. Air cooling is sometimes used for intricate shapes to prevent cracking.

Table 4—Annealing Temperatures or Martensitic Stainless Steels

Material Type	Temperature* (deg F)	
	Low Anneal	Full Anneal
403, 410, 416, 416Se	1200-1400	1500-1650
414	1200-1300	——
431	1150-1225	——
420, 440A, 440B, 440C	1350-1450	1550-1650

*Workpieces to be cooled slowly from these temperatures, preferably in a furnace.

grit wheel, from No. 24 to No. 36 is used initially, at speeds of 5000 to 6000 fpm. A finer grit wheel, up to No. 60, should be used for final grinding.

Abrasive belt machines, *Fig.* 5, swing grinders, and pneumatic and electric hand machines are used to remove heavy grit lines in polishing. Increasingly finer abrasives are used to produce a smooth finish prior to buffing. Final polishing with a 120 grit, using abrasive belts or flexible wheels of unbleached muslin, produces a No. 4 mill finish. An aluminum-oxide abrasive with wheel speeds of approximately 7500 fpm is used. Lubricants such as grease or tallow, which are heavy and restrict cutting action, produce smoothest finishes. Generally, a 240 grit is considered the minimum fineness for polishing prior to buffing. This grit size provides a base for a No. 8 finish.

Buffing: Two operations are performed in buffing: cutting and coloring. The cutting operation removes a small amount of metal while coloring

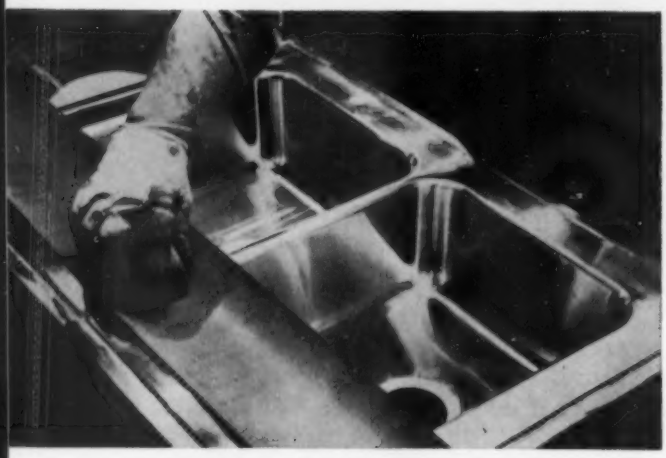


Fig. 5. Traveling abrasive belt is used to finish weld areas on Type 302 stainless-steel sink top. Finish produced with a 120 grit approximates a No. 4 standard mill finish.

brings out texture and produces a mirror finish. Aluminum-oxide abrasives, and muslin or sisal buffs are generally used at speeds of 8000 to 10,000 fpm. Since considerable pressure must be exerted on the work during the coloring operation, adequate amounts of compound and ventilated type wheels will help to avoid local overheating.

Barrel Polishing: Parts that are difficult to buff, because of size, shape or quantity, can be finished by barrel polishing. Barrel finishing methods are of two types: deburring and ball burnishing ("bright finishing"). Granite chips are generally used for the deburring operation. Dead-soft, stainless-steel balls and barrel speeds of approximately 20 rpm are best for burnishing. Vienna lime or soap and water aid cutting action.

Electropolishing: Intricately shaped parts can also be bright-finished by electropolishing. Equipment similar to that used for plating is required, but metal is removed, since the work is the anode. Normally, 0.0005 to 0.0015 inch of metal is taken off by this method; it is not intended to remove deep surface defects. Water and alcohol rinses are used to remove any residue from electrolysis. When good base finishes are provided, mirror-like finishes, can be obtained by electropolishing.

Etching, Blackening and Coloring: Mechanical etching is usually performed on highly polished sheets or strips of stainless steel. For pronounced surface contrast, a No. 7 or No. 8 finish is preferred. A mask or template is placed over the surfaces which are to remain bright and the remaining areas subjected to sandblasting, grinding, or brushing with tampico or stainless-steel wire brushes. Masking materials are removed with solvents.

Chemical etching methods can be used to produce intricate designs on stainless-steel surfaces. The pattern desired is etched on a zinc master plate. The master plate is placed in an offset press, inked, the design transferred to a rubber blanket, then transferred to the stainless-steel sheet. A special powder, dusted on this inked area, is fused in position by slow heating. The protective coating thus formed serves to sharply define areas that are to be etched. Etchants strongly acid in character, such as a ferric chloride—hydrochloric—nitric acid solution, are generally used.

Blackening, to produce nonreflective black oxide surfaces, is done by dipping stainless-steel parts in hot chemical oxidizing baths. Nickel plating or copper plating (followed by further treatment with ammonium sulfide) can also be used to blacken stainless steel. Glossy textures can be produced on these surfaces by finishing with oil or wax. Since plating methods produce somewhat lowered corrosion and abrasion resistance, the effects of these finishing methods on end use must be considered.

A new process for coloring stainless steel has recently been developed for architectural and other decorative applications. At present a glare-reducing black matte finish is the only color available but development efforts have been concentrated on other colors for which there are indicated applications, primarily golds and bronzes. The process involves applying a pigment in a special vehicle to prepared surfaces by spraying or roller coating, followed by controlled temperature treatment in a dust-free atmosphere. The method is unusual in that stainless sheets so treated can be deep drawn or bent without cracking the applied colors.

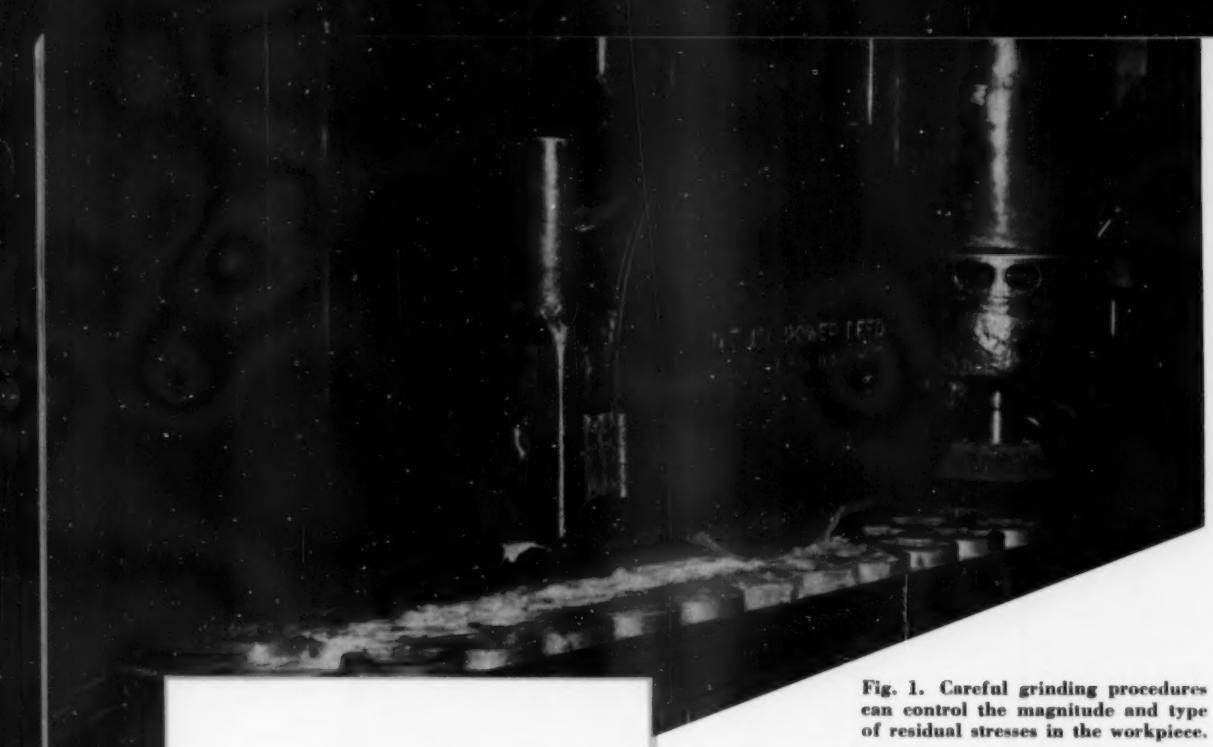


Fig. 1. Careful grinding procedures can control the magnitude and type of residual stresses in the workpiece.

controlling GRINDING STRESSES

By A. L. Ball*

Residual grinding stresses in a workpiece can be controlled within limits, both with respect to type and extent. Examples demonstrate effects of wheel type, downfeed and coolant on stresses in hardened steel. Bath and quench also effectively reduce stresses. Critical effects of downfeed in grinding titanium are also discussed.

*Member of the Research Technical Subcommittee of the Grinding Wheel Institute and Abrasive Grain Association. This article is based upon research sponsored by these organizations at the Mellon Institute of Industrial Research.

INTERNAL RESIDUAL STRESSES exist at, and slightly below, the surfaces of metals which have been processed or shaped by machining or grinding processes. These residual stresses can, by suitable measurements on selected shapes, be identified as tensile, compressive, or compressive at the surface and tensile a few thousandths of an inch below the surface and so on. The degree and nature of the stresses can play a part in the success of a mechanical element during its service life.

Recently, it has been shown that the fatigue failure of flat, surface-ground steel strips is not adversely affected by moderately high tensile stresses, nor by high compressive stresses.[1] It is generally believed, however, that high residual tensile stress is not beneficial and that high residual compressive stress enhances the strength of a part.

This article discusses grinding procedures and conditions which introduce residual stress in a metal. Also, methods to reduce the magnitude of residual stresses are presented. The selection of a particular stress to remain in a machined part will be left to the designer of such a part based on his knowledge of its intended use.

The data has been obtained from extensive work done by H. R. Letner and others for the Grinding Wheel Institute. Illustrative examples, applicable to surface grinding hardened steels, *Fig.* 1, show

[1]References are listed at end of article.

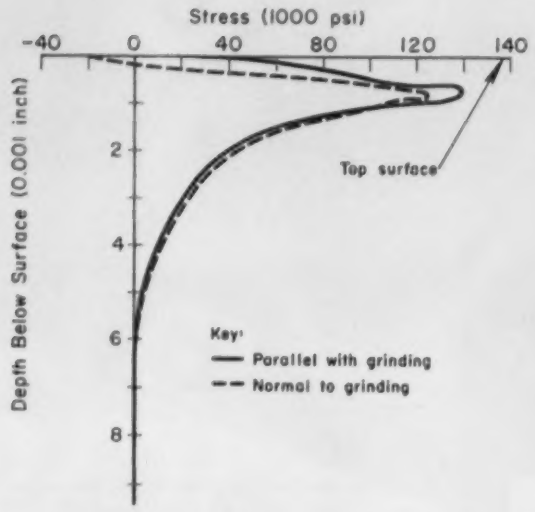


Fig. 2. High residual stresses resulting from grinding a hardened ball-bearing steel. Solid line shows stress parallel to direction of grinding. Dotted line is the stress perpendicular to the direction of grinding.

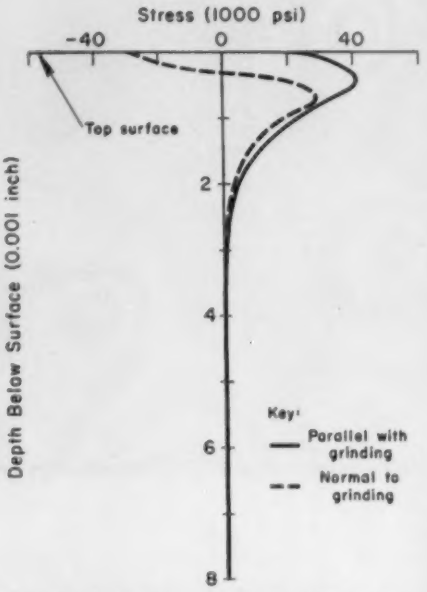


Fig. 3. Residual stresses are reduced by using a softer wheel than that used in *Fig.* 2.

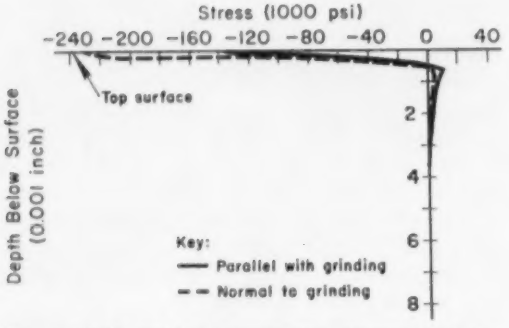


Fig. 4. High surface compressive stresses are obtained with a harder wheel. An M grade wheel and oil coolant were used.

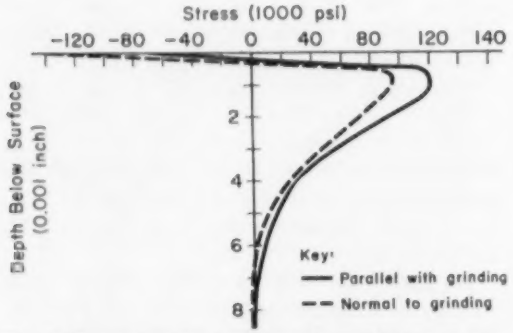


Fig. 5. Increasing the downfeed from 0.001 to 0.002 inch greatly increases the subsurface stresses from those recorded in *Fig.* 4.

how grinding can bring about the various types of stress conditions. Five basic examples will be covered in the following:

High Residual Tensile Stress: A residual tensile stress of approximately 45,000 psi in magnitude at the surface and 130,000 psi at 0.001 inch below the surface resulted from surface grinding a hardened ball-bearing steel with a white aluminum oxide wheel in a series of tests.

The distribution of residual stresses existing in the workpiece after surface grinding is shown in *Fig.* 2. The material was vanadium BB ball-bearing steel hardened to R_C 59. The following were used:

Wheel: White aluminum oxide, 46 grit, J grade, vitrified, 8 x ¾ x 1¼ in., dressed prior to grinding the surface.
Wheel speed: 6000 fpm
Traverse speed: 60 fpm
Crossfeed: 0.050 in.
Unit downfeed: 0.001 in.
Total downfeed: 0.010 in.
Grinding fluid: oil-water emulsion.

The solid line in the chart represents stresses parallel to the grinding direction; the dotted line represents stresses perpendicular to the grinding direction. Details on the derivation and plotting of these curves are discussed by Letner.[2] In *Fig.* 2 the stress at the surface is about 45,000 psi, while the peak stress is 130,000 psi, 0.001 inch below the

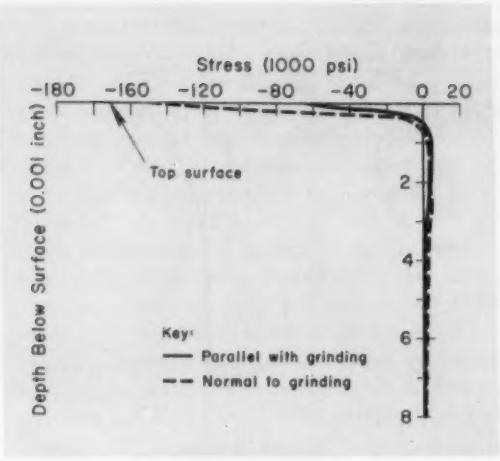


Fig. 6. Using fine feeds and an F grade together with coolant keeps stresses at low values.

surface. The stresses in this case are tensile and are plotted as positive coordinates. Negative values represent compressive stress.

Low Residual Tensile Stress: A residual tensile stress of only 25,000 psi at the surface and 40,000 psi at 0.0005 inch below the surface was left in a workpiece by grinding with an H grade, 8 structure wheel. *Fig.* 3 shows the plot of the stress condition. Grinding factors were the same as those in the previous example with the exception that the wheel was two letter grades softer.

High Compressive Stress: Use of an M grade wheel, a downfeed of 0.001 inch and a grinding oil coolant produced surface compressive stresses of 120,000 psi magnitude, while at a depth of 0.0005 inch the stress is only 5000 psi tensile.

In *Fig.* 4 is represented the final stress situation in the metal. It should be pointed out that an increase in downfeed to 0.002 inch brought about a striking change in the residual stress distribution pattern as shown in *Fig.* 5. The surface stress is still compressive at about 80,000 psi but a 120,000-psi tensile stress exists at 0.001 inch below the surface. If predominantly compressive residual stress is desired to the virtual elimination of subsurface tensile stress, then proper wheel grades, coolant, downfeed, etc., must be used, otherwise the stress situation could become tensile in character.

Low Compressive Stress: Use of an F grade, induced pore type wheel for several downfeeds of 0.001 inch followed by four downfeeds of 0.0005 inch, in a wet surface grinding operation using a 1-50 dilution of soluble oil as coolant left a 60,000 psi compressive stress at the surface with zero

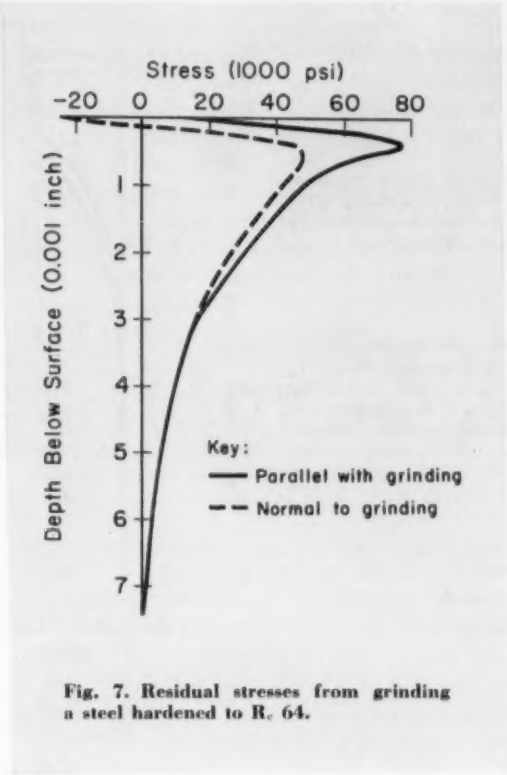


Fig. 7. Residual stresses from grinding a steel hardened to R_c 64.

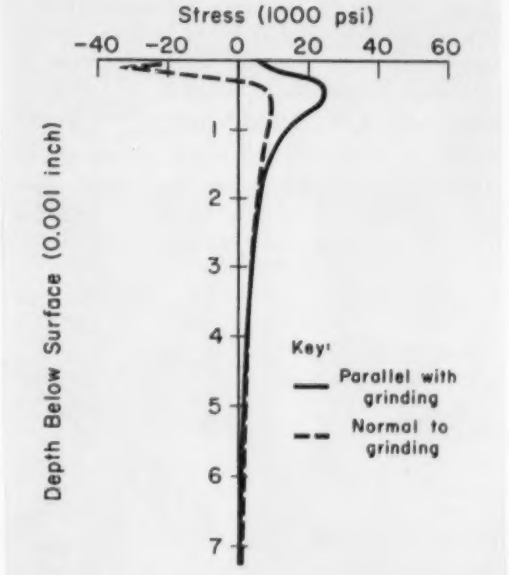


Fig. 8. Reduction of stresses in steel shown in *Fig.* 7 by salt-bath immersion followed by oil quench.

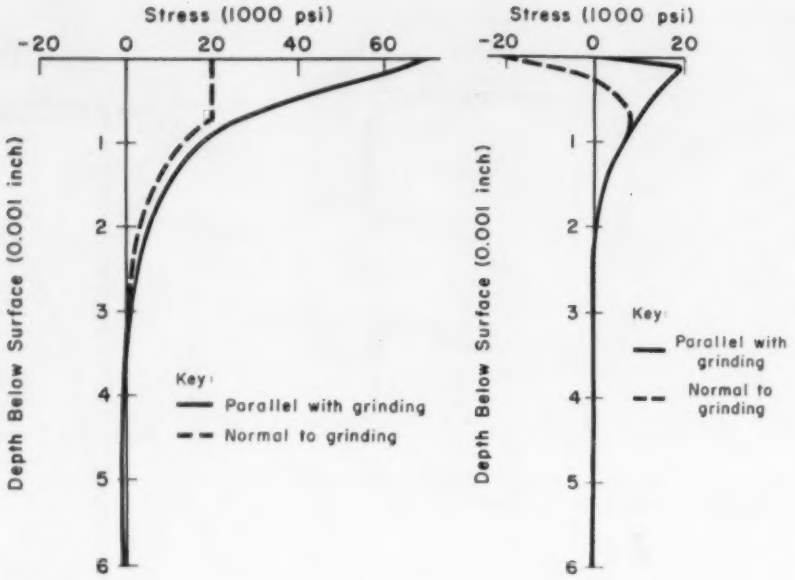


Fig. 9. (left) Residual stresses remaining after grinding a steel having a R 59 hardness.

Fig. 10. (right) Reduction in stress shown in *Fig.* 9 after steel is immersed in salt bath followed by water quench.

tensile stress at 0.0005 inch below the surface, and only 2000 to 3000-psi tensile stress 0.002 inch below the surface. The nature and distribution of residual stresses existing in a workpiece ground according to the foregoing is shown in *Fig.* 6.

Reduction of Existing Stress: Extensive studies have ascertained that definite procedures can reduce or remove residual stresses from a metal workpiece.[3] Obviously, the annealing methods should be selected to reduce hardness values as little as possible. The preferred methods are presented with stress diagrams illustrating stress relationships in steels of R_C 64 and R_C 59 before and after annealing under what are considered the most practical methods associated with minimum reduction in hardness.

In *Fig.* 7 is shown the relatively high-residual tensile stresses remaining in a steel which had been hardened by oil quenching and tempering to a hardness of R_C 64 and then surface ground with an 8 x 0.75 x 1.25-inch soft grade, medium structure, vitrified bonded wheel. Grinding conditions were: wheel speed, 6000 fpm; traverse speed, 60 fpm; unit crossfeed, 0.050 inch per table stroke. Ten downfeeds of 0.001 inch were removed with the wheel diamond-dressed immediately before use.

The marked reduction in residual stress brought about by a 5-minute immersion of the part in a salt bath at 420 F followed by quenching in oil at 85 F

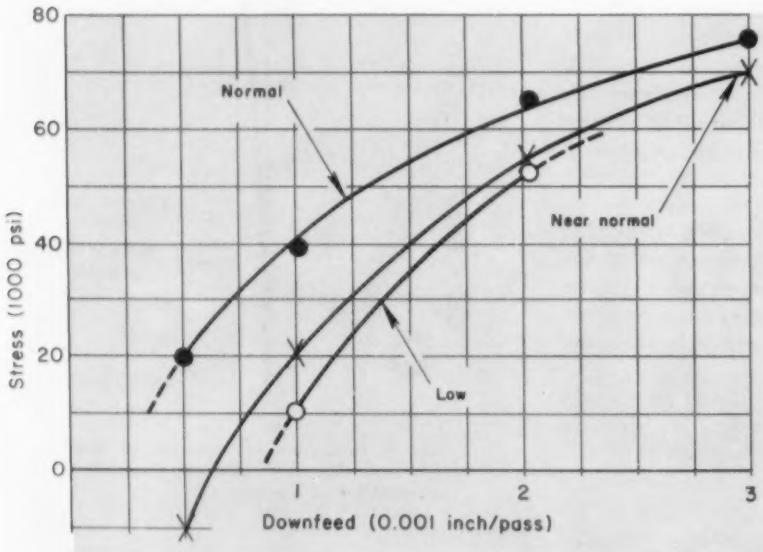


Fig. 11. Maximum stresses in titanium plotted for low, near-normal and normal speed methods.

is illustrated in *Fig.* 8. The Rockwell hardness was reduced only 2.8 points, leaving the steel at R_C 61.2.

Stress patterns shown in *Figs.* 9 and 10 were obtained when working with steel hardened as in the foregoing example and then tempered to yield a hardness of R_C 59. Subsequent surface grinding on these pieces was the same as for pieces represented by *Figs.* 7 and 8.

The comparison of residual stress patterns for steel in *Fig.* 9, as ground, against *Fig.* 10, after a 90-second immersion in a salt bath at 600 F followed by a quench in water at 80 F, shows how marked a reduction was brought about in residual tensile stress while the Rockwell hardness dropped only 0.6 point. A rapid treatment such as this could readily be adopted as a production step.

Stress in Nonferrous Metals: Residual stresses are present in ground workpieces of materials other than steel, for example, titanium[4]. The degree of stress depends upon a number of grinding factors, some of greater significance than others. Increasing depth of feed is a strongly effective factor and definitely increases residual stress as shown in each of the curves in *Fig.* 11. This type of change also occurs with hardened steel.

In a certain instance a drastic reduction in rate of downfeed, i.e., from 0.003 to 0.0005 inch changed the stress from tensile to compressive. A change such as this could modify the performance characteristics of a mechanical member subjected to heavy externally applied loads.

These examples show that—by a selective choice of grinding procedures—either compressive or tensile stresses of varying magnitudes may be produced. Machine designers can make practical use of the disclosed methods since they are within the scope of normal grinding procedures.

References

1. Tarasov, L. P., W. S. Hyler and H. R. Letner—"Effect of Grinding Conditions and Resultant Residual Stresses on the Fatigue Strength of Hardened Steel." *Proceedings, American Society for Testing Materials*, pp 601-622, 1957.
2. Letner, H. R.—"Residual Grinding Stresses in Hardened Steel," *Transactions, ASME*, pp 1089-1098, October 1955.
3. Letner, H. R. and A. B. Sauvageot—"Relief of Residual Grinding Stresses by Annealing." *Metal Progress*, September 1957.
4. Clorite, P. A. and E. C. Reed—"Influence of Various Grinding Conditions upon Residual Stresses in Titanium." *Transactions, ASME*, pp 297-301, February 1958.

Broaching Technique for Miniature Gears

A METHOD for "knurl" broaching solves a problem at Librascope, Inc. which was having trouble mounting miniature precision gears on hubs without deformation of the gear concentricity.

The job involved requires mounting tiny precision ring gears on hubs of a miniature two-pinion differential used in analog computing equipment, and other precise electromechanical equipment where shaft rotations must be compared. The 1.06-oz. differential will accept a maximum gear input speed of 1200 rpm with a recommended maximum static load of 6 in-oz. Overall length of the unit is 0.980 inch, with a working circle of the entire differential package of only 1.090 inches.

Bevel gear hubs, to which the $\frac{1}{8}$ inch wide aluminum or brass ring gears are fitted, are No. 416 stainless steel, with diameters of 0.5000 and 0.6880 inch. The differentials are designed for ambient temperature ranges of from −65 to +160 F.

The ring gears, which act as side drive gears, are generally too small for use of pins or setscrews. Cutting through the gear to provide for a pin causes loss of concentricity when thermal expansion takes place, and precision tolerance limits may be exceeded. Results are increased backlash and often gear damage. Inserting setscrews brings the same problem. Drilling and tapping walls of the ring gear introduces distortion, and pressure exerted by the screw forces the outer circumference out of round.

In the successful adaptation of the "knurl" broaching technique, a fine pitch knurl, usually 80 pitch, is applied to the hub surface. Knurling increases the diameter of the hub by 0.004 to 0.005 inch in the local area. The principle is similar to that of shaft splining. Knurl pitch is dependent on load to be transmitted; use of an 80 pitch knurl provides 50 in-lb minimum torque.

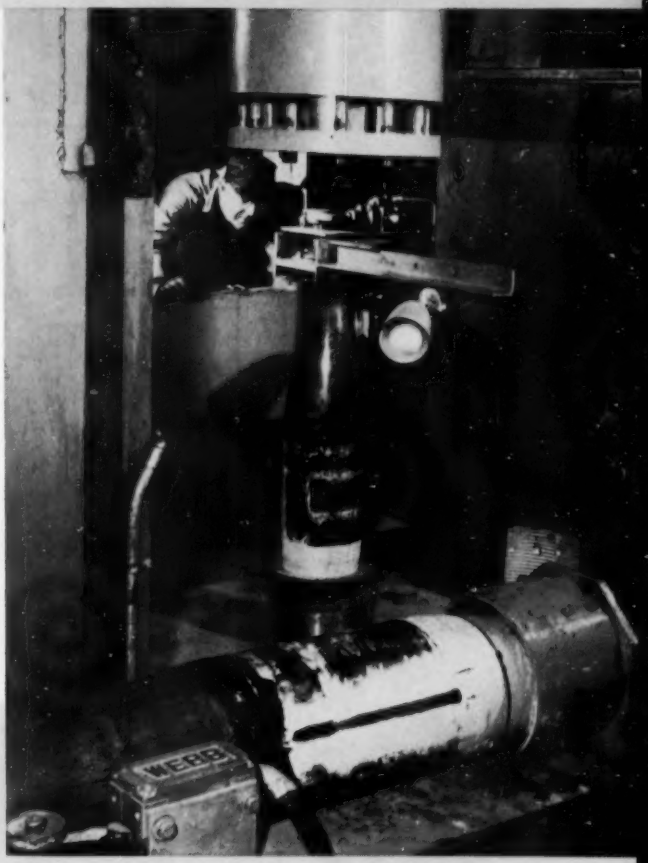
Base of the hub is knurled to slightly less than half the width of the ring gear to be applied. Then a groove is machined around the hub at the leading edge of the knurl. Actually, this chip groove which cuts across the ends of the knurling, forms sharp edges which act as microscopic broaching teeth as the ring gear is pressed onto the hub. The groove collects material removed from the ring gear and prevents galling and spalling of the metal.

In the completed job, about 60 percent of the interior surface in the ring gear adjacent to the hub mates with the hub within a tolerance of 0.004 inch. The remaining 40 percent is utilized for the knurl broaching and chip groove.

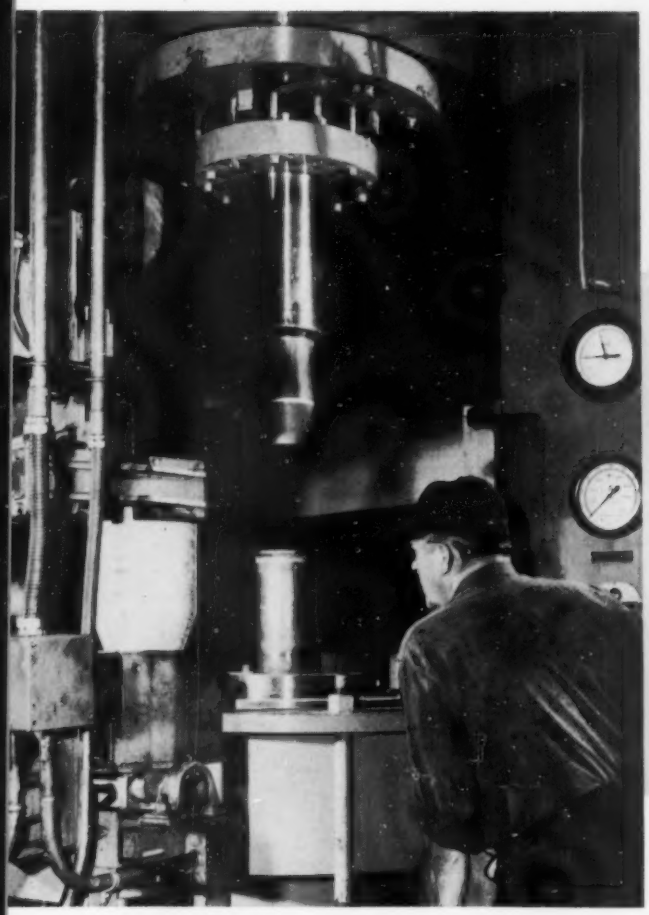
PORTABLE INSTRUMENTS are used for checking worn mill rolls during processing for re-use at The Tool Steel Gear and Pinion Co. Rolls are first tested for surface and subsurface defects by reflectoscope as shown here. Rolls that pass inspection are subjected to a heat-treatment process capable of producing uniform hardness to meet specific rolling conditions.

AFTER HEAT TREATMENT, rolls are inspected using Pentroscopes and Shore roll scleroscopes. Once rehardened, potential service life is equal to that of new rolls. After a roll has been worn down to its minimum size for a mill, it is reworked for a smaller mill and again put into use.

TOOLS at work

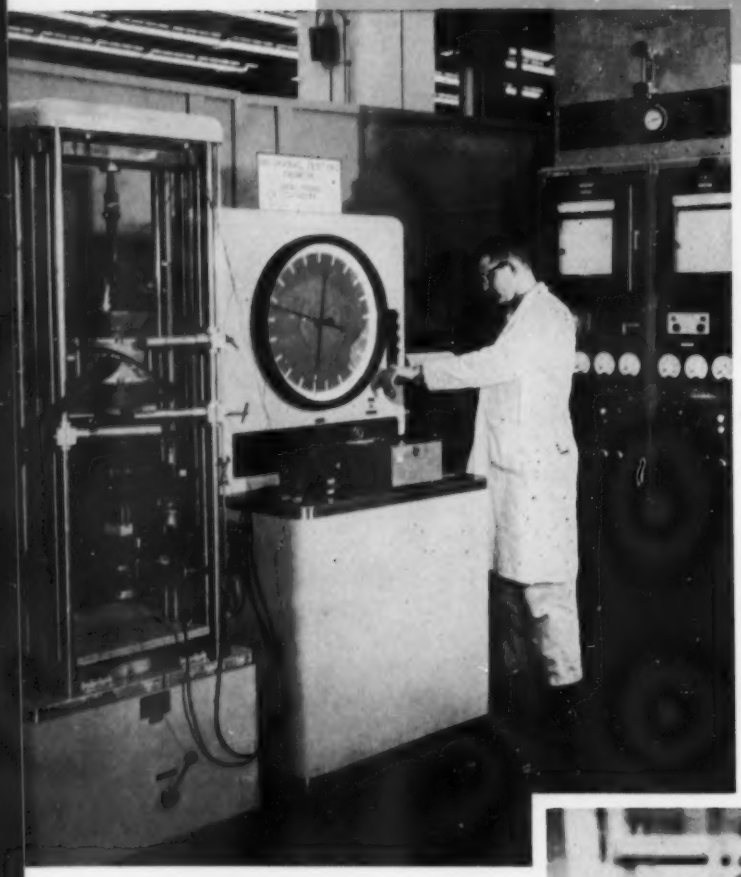


NOSE of eight-inch steel shell is automatically tapered to a two-inch open end. After nosing, the shell wall is ready for finish machining.

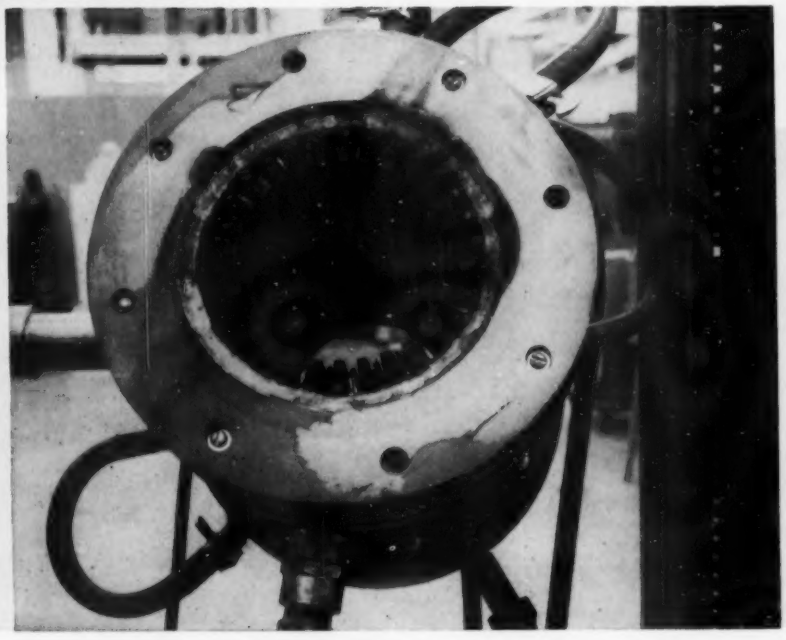


LOW-CARBON STEEL is formed by a hot-cup cold-draw process into eight-inch artillery shells. The technique provides better ballistic properties, saves material and eliminates a heat-treating step. A billet is hot forged into a cup at 2150 F, then forward cold extruded to final shape. Here a worker checks forward extrusion of shell. Hot-cup cold-draw method was developed at American Car & Foundry Div. of ACF Industries, Inc.

TOOLS at work



QUICK-HEAT SOURCE permits tensile testing under temperature conditions of simulated flight. Developed by Boeing Airplane Co., the furnace shown here is used with a universal testing machine. Power for the furnace is supplied through the pair of ignitron units at the right. These electronic power units allow immediate control of heating and the time required to reach operating temperature. Although most material testing is programmed for constant temperature, the ignitrons permit heat cycling if desired for special applications.

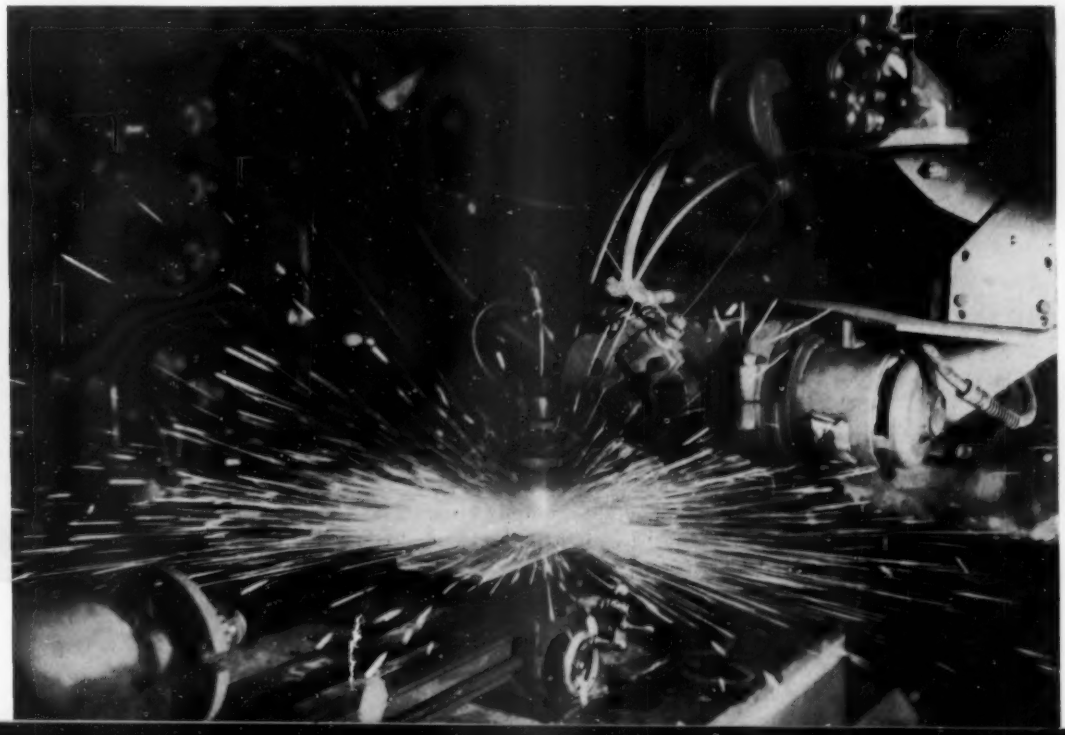


QUICK-HEAT FURNACE will reach 3500 F in 90 seconds. Quartz heat lamps supply the elevated temperature. By arranging 30 lamps in a circle surrounded with a copper water-jacket cooling system, standard lamps are operated at over twice the manufacturer's rating. The inside of the furnace is gold plated for better heat reflection.

NOZZLE LINER is fabricated of tungsten by applying successive coatings on a spinning mandrel until desired thickness is reached. Mandrel is then dissolved out, leaving the part unaffected. Earmuffs are worn as protection against the high-pitched noise of the arc.

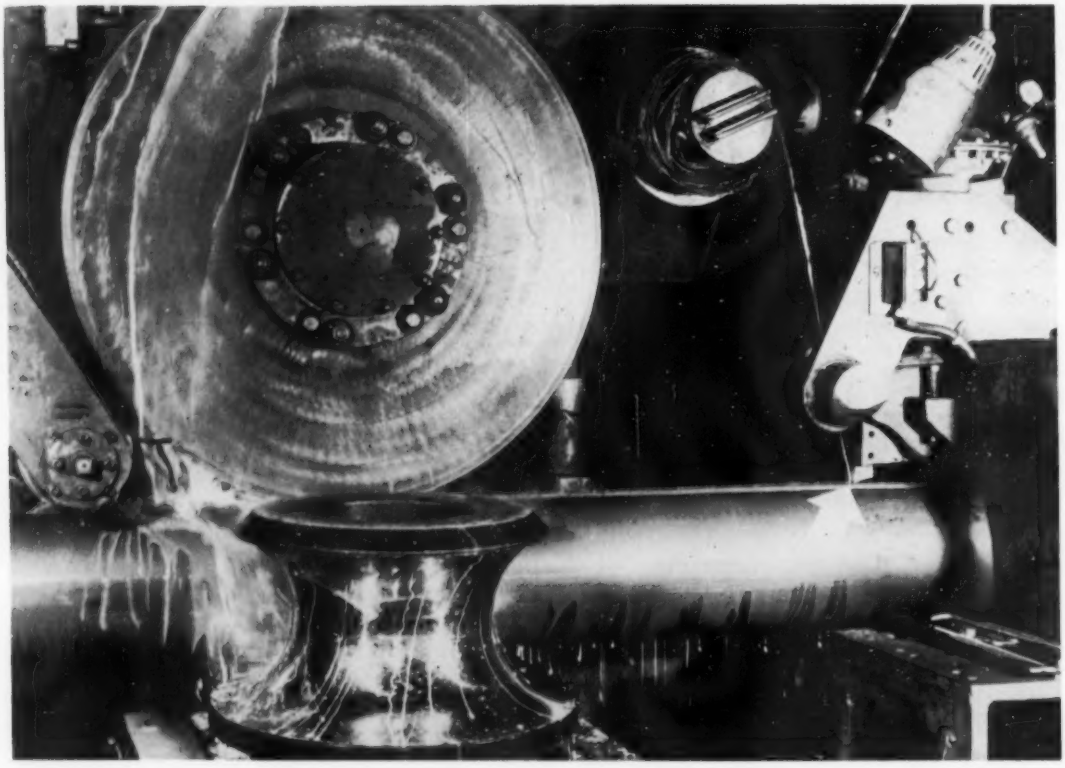
NOSE CONE FOR A MISSILE is given a heat-resistant tungsten coating with a plasma arc torch developed by the Linde Co. The torch, capable of producing temperatures between 15,000 and 30,000 F, can be used either to apply coatings or fabricate shapes. Tungsten is drawn into the torch in powder form, melts in the heat of the electric arc, and is carried out of the nozzle by a continuous flow of inert gases. The tungsten particles, still in fluid or plastic state, strike the nose cone at near sonic speed and are cooled at once by sprays of carbon dioxide.

WIRE FED TORCH coats stainless steel on an aluminum plate as the plate is traversed. Wire, fed from a spool, is preheated to obtain higher feed rates.



TOOLS at work

AUTOMATICALLY CONTROLLED, two 12-foot Pangborn Rotoblast barrels process approximately 33 tons of gray iron castings per day at Master Electric Co. Three men handle the barrels, gating and stacking during the blast cleaning operation. The load is automatically charged into the machine and the loader returns to position. The barrel door closes and the blast action begins. At the end of a ten minute cycle, the blast action stops, the doors open, the work conveyor reverses itself and discharges the load into an oscillating conveyor. This conveyor moves the load to a special batch transport car which carries the parts to inspection, grinding, chipping, machining and assembly areas. Typical castings cleaned are motor end bells, motor end frames, bearing housings and gear cases.



SCARFING THE EXTERNAL AND INTERNAL WELD BEAD on continuously welded pipe is done with carbide indexable inserts at Beall Pipe & Tank Corp. The feed is 50 to 60 fpm. The weld bead is cut in a continuous stream, and the scrap is wound automatically on a spool. Changing to carbide tools enabled the feed to be almost doubled and eliminated the bead sticking to the tool. The inserts are CA-610 made by Carmet, a facility of Allegheny Ludlum Steel.

designing FORM TOOLS for optimum use of side clearance

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When it is possible to provide side clearance on flat and circular forming tools, product quality is improved and tool life is extended. Some workpiece configurations that seem to prohibit the use of side clearance actually are compatible with tools of this design.

SIDE CLEARANCE ANGLES promote tool life. In many instances, however, they are omitted simply because the workpiece configuration appears to prohibit such clearances.

Fig. 1 shows a typical example. If the form tool shown were made in two separate sections (*A* and *B*), side clearance would naturally be applied to surfaces *e* and *f*. Sharpening would, of course, increase distance *C*, necessitating the resetting of tool *A* after sharpening.

*Senior member ASTE Springfield chapter.

If, however, the tool were made in one piece (*D*) and the entire form were ground at the side clearance angle on surfaces *e* and *f* to keep the configuration constant despite sharpening, this would seem to introduce a rubbing action on surface *g*. On this premise, designers often prescribe no side clearance, a condition which leads to inferior product finishes and shortened tool life.

When the situation is analyzed further, it will be seen that a certain amount of side clearance is possible without causing surface *g* to rub. In *Fig.* 2, the dotted lines depicting the runout of the front clearance angle on the form reveal that an effective side clearance exists at *h*. If some of this angle is applied to surfaces *e* and *f* as side clearance and the entire form is ground at that angle, a constant configuration is maintained throughout the life of the tool, yet a positive side clearance is provided on the entire form, as seen in *Fig.* 3.

TABLE 2 shows, for typical combinations of chamfer and front clearance angles, resultant amounts of effective side clearance angles at *h*. These angles can be apportioned as desired to provide side clearance on the straight sides of the cutting form. For other combinations of these angles, resultants for the next smaller angles are used, or they can be calculated with the formula $\tan h = \tan Y \ (\sin Z)$, where *h* is side clearance angle, *Y* is chamfer angle and *Z* is front clearance.

Fig. 1. Design of typical circular form tool. If the tool were made in two separate sections (*A* and *B*) side clearance would be applied to *e* and *f*.

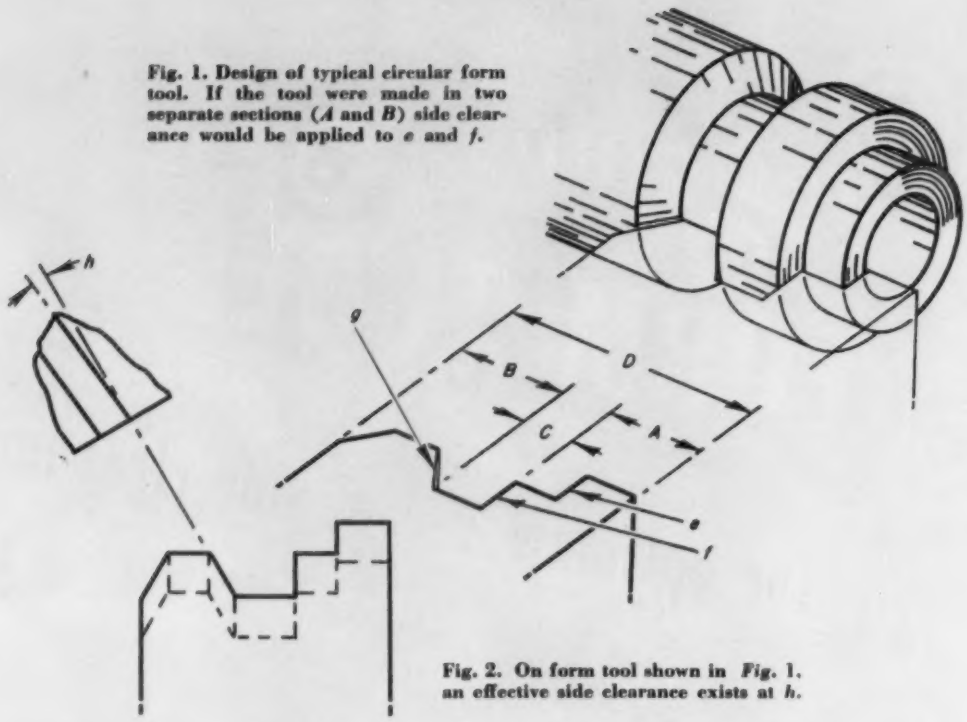


Fig. 2. On form tool shown in *Fig.* 1, an effective side clearance exists at *h*.

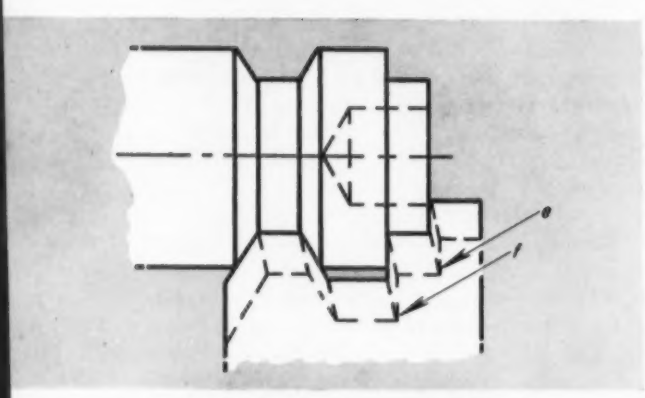


Fig. 3. Positive side clearance can be maintained on entire tool shown in *Fig.* 1 by applying side clearance to surfaces *e* and *f*.

Table 1—Effective Side Clearance Angles

Chamfer Angle (deg)	Front Clearance Angle (deg) 4	5	6	7	8	9	10
10	0°42′	0°52′	1° 3′	1°13′	1°24′	1°35′	1°45′
15	1° 2′	1°18′	1°34′	1°49′	2° 5′	2°21′	2°37′
20	1°22′	1°43′	2° 4′	2°24′	2°45′	3° 6′	3°27′
25	1°42′	2° 7′	2°33′	2°58′	3°24′	3°50′	4°16′
30	2° 0′	2°30′	3° 0′	3°31′	4° 1′	4°32′	5° 2′
35	2°18′	2°52′	3°27′	4° 2′	4°37′	5°11′	5°47′
40	2°34′	3°13′	3°52′	4°31′	5°10′	5°49′	6°28′
45	2°50′	3°32′	4°15′	4°58′	5°41′	6°23′	7° 6′

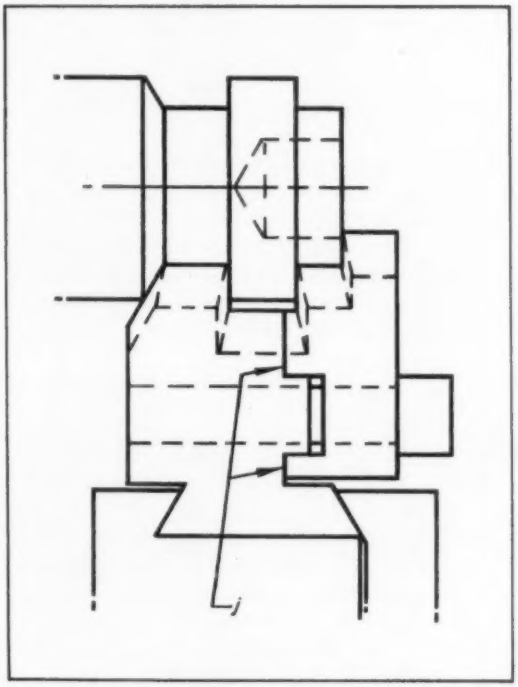


Fig. 4. Tool made in two sections. Periodic grinding of surface *j* compensates for successive sharpenings of tool.

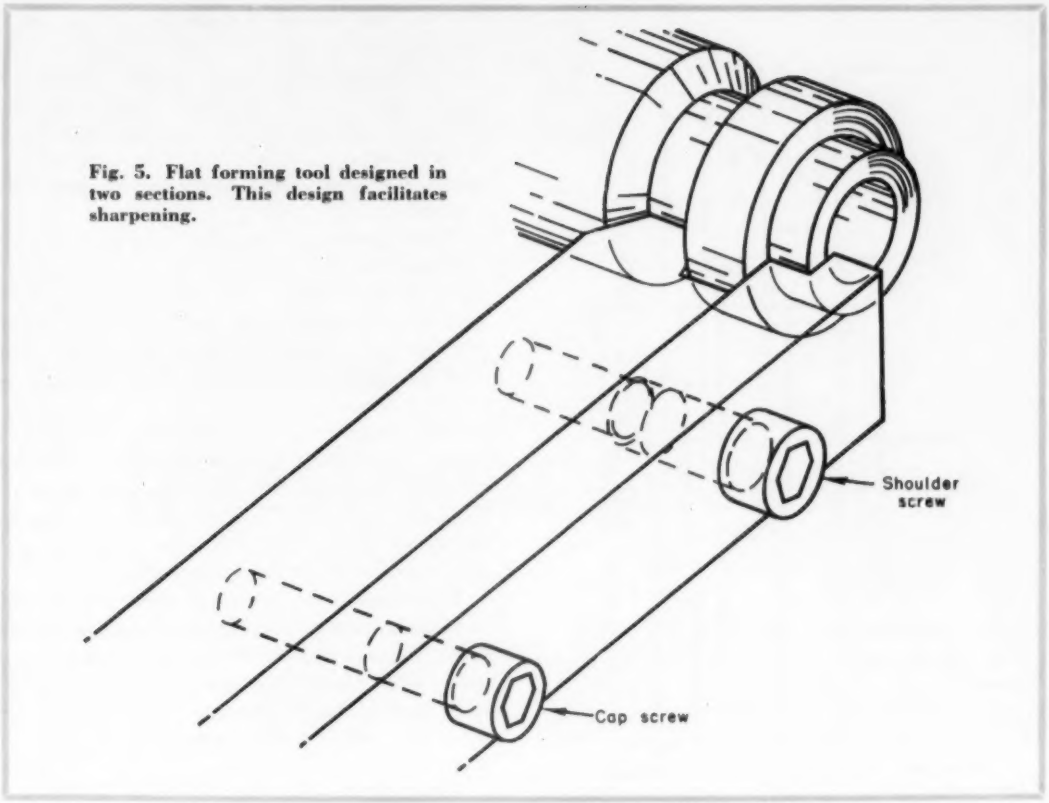


Fig. 5. Flat forming tool designed in two sections. This design facilitates sharpening.

With a component designed as in *Fig.* 4, no side clearance is practicable in a solid tool. However, tools can be made in sections and each part treated as a separate tool with regard to application of side clearances.

In the illustration, the collar portion of the workpiece determines the point of separation in the tool. Side clearance, applied to each half of the tool, falls away from this collar portion. This, of course, widens the collar with successive sharpenings of the tool, a condition that is easily remedied by periodic grinding of surface *j* on the more accessible half of the tool. Proper relationship of the entire form at the cutting edge is maintained through the use of a key and key slot.

For flat forming tools, this relationship can be maintained by clamping the two sections together with one standard shoulder screw (which also serves as a dowel) and one standard capscrew, as shown in *Fig.* 5.

In the case of circular form tools, side clearance can be obtained by grinding the entire cutting form on a helix. Since the width of the basic tool is increased in proportion to this helix angle, the degree of side clearance is necessarily limited. TABLE 2 shows the amount of increase in width that

Table 2—Increase in Width of Circular Form Tools*

Side Clearance Angle		Tool Diameter (inches)									
(deg)	(min.)	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.50	4.00
0	30	0.034	0.041	0.048	0.055	0.062	0.069	0.075	0.082	0.096	0.110
1	0	0.069	0.082	0.096	0.110	0.123	0.137	0.151	0.165	0.192	0.219
1	30	0.103	0.123	0.144	0.165	0.185	0.206	0.226	0.247	0.288	0.329
2	0	0.137	0.165	0.192	0.219	0.247	0.274	0.302	0.329	0.389	0.439
2	30	0.171	0.206	0.240	0.274	0.309	0.343	0.377	0.411	0.480	0.549
3	0	0.206	0.247	0.288	0.329	0.370	0.412	0.453	0.494	0.576	0.659

*With each direction of side clearance.

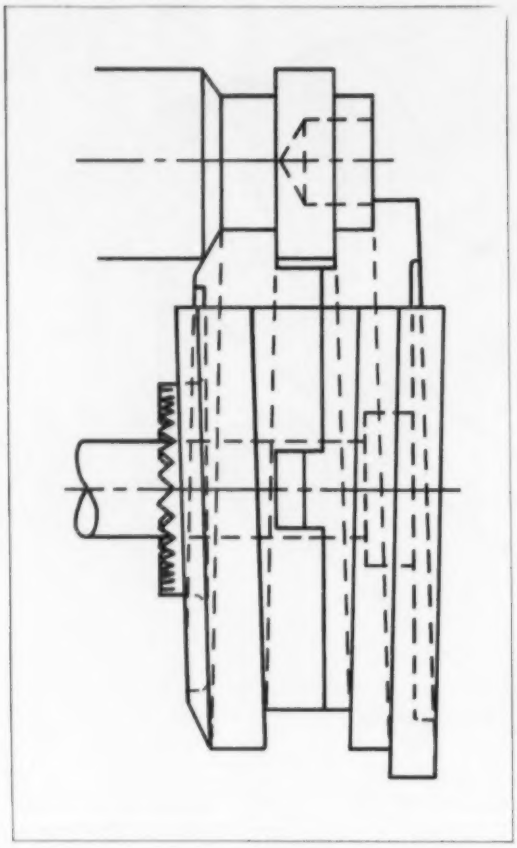


Fig. 6. Proper relationship of two halves of cutting form is maintained by means of key and key slot arrangement that also expedites adjustment.

results from various side clearance angles as applied to some common tool sizes.

In referring to TABLE 1 to establish side clearance angles for circular tools, the effective front clearance angle must first be found by applying the formula $\sin Z = m/n$, where Z is front clearance angle, m is work offset distance and n is largest tool radius.

When designing a circular form tool with side clearance for the workpiece shown in *Fig.* 1, the entire form follows a helix that recedes from the collet in the machine, a condition which permits the use of maximum clearance angles. This, however, is not true when applying a similar form tool to the workpiece shown in *Fig.* 4. As in the case of the straight tool, side clearance recedes from either side of the collar portion of the component, thus widening the circular tool in both directions. In some cases, this will necessitate holding the workpiece farther from the collet to accommodate the added width on the inboard side of the tool.

In computing the increase in width of these tools, a value for each side clearance angle is selected from TABLE 2 and the two are added to the basic tool width. Maintaining proper relationship of the two halves of the cutting form is achieved by means of a key and key-slot arrangement as shown in *Fig.* 6.

Although the range of application of side clearance to tools with intricate forms is limited, there are nevertheless many instances where its use can be justified by the results in improved product quality and increased tool life.

Numerical Control Cuts Aircraft Production Time

RECENT INNOVATIONS in numerical control are netting dramatic results in the automatic control of continuous contour machine tools. Numerical control now encompasses the over-all manufacturing system in a plant from the engineering drawing through a finished part.

As a result, industry is realizing high production lead time savings because no templates, cams, models or complicated fixtures are required. Cost savings, as reported by Industrial Controls Section of Bendix Aviation Corp., run as high as 80 percent on numerically controlled machines. At the same time, machining costs drop because numerically controlled machines can operate at maximum speeds and feeds during all parts of a cycle without need for stopping for inspection or setup. Without human error, machining operation scrap rates are reduced to a minimum. Tool life tends to increase because the tool is always correctly loaded.

Example of the industrial advantages appears in the work of Boeing Airplane Co. which utilizes a numerical control system developed and built by Bendix to control a Kearney & Trecker profile milling machine. The equipment machines two complex aluminum forgings and a reinforcing doubler. In manufacture of the reinforcing doubler, the numerically controlled three-axis milling machine performs surface, profile, straight line and circular cutting operations on aluminum stock. During machining, a spindle speed of 3600 rpm is used; and flat areas, circles and profiles are machined at a rate of 80, 15 and 60 ipm respectively.

In this case, numerical control results in an 80 percent saving in lead time (from five days to one day), and a 90 percent saving in machining time (from 25 hours to 1.2 hours). Time for hand finishing dropped from two hours to 10 minutes because of the quality surface finish achieved. Machining time per part in production had required six hours; with numerical control, a half hour is needed.

designing for Investment Casting

MANY TIMES the versatility of the investment casting process will make it more economical than forging, stamping, die casting or other mass production methods. Possibilities for cost savings exist when:

Machining operations can be reduced or eliminated
A part can be made to perform better by using tough-to-machine super-alloys
A part can be redesigned to replace several machined parts with one investment cast part
Soldering, welding or mechanical fastening is undesirable
The quantity is small
Design is likely to change
Only a few hundred pieces are desired for proving designs before tooling for large production runs.

Design Rules

Ideally, the time for deciding if a part is to be investment cast is when it is on the drawing board. While it is easy to modify a design of a machined part to suit it for investment casting, it is easier to design for the process than to redesign. Curved and blended contours result in stronger parts than straight lines and abrupt angles, and usually cost less. Nevertheless, if a part design requires a sharp angle, it can be investment cast. A second rule deals with surface finishes. This can be simply summed up: Where surface finishes aren't critical, design for the process; where finishes are critical, leave ample stock so finishing operations will completely remove the as-cast surface. Allow 0.010 inch for a ground finish. For small parts to be machine-finished, allow 0.032 inch if warpage or out-of-roundness is not involved. Leaving enough stock is particularly important with machine finishing. Users of investment castings have found that they can cut setup time and lengthen tool life when there is enough extra metal to let the tool get below the somewhat abrasive casting surface quickly.

A third rule is: Never hesitate to pick the best metal or alloy for the job. The amount of money saved by specifying an inferior material usually amounts to only a few pennies per casting. One of the greatest advantages of investment casting is the freedom in alloy selection.

Tolerances

Designers should avoid specifying needlessly close tolerances in non-critical areas. A strong tendency exists to make engineering drawings to machining tolerances, leading to overspecification. For dimensions that are not critical, generous casting allowances will result in lowest possible production costs.

General Tolerances: The rule-of-thumb investment casting tolerance of ± 0.005 inch per inch produces a low-cost casting, but specifying ± 0.010 inch per inch is even more economical. If an extremely small casting is desired, tolerances closer than ± 0.005 inch can often be held in one or several dimensions. The minimum is approximately ± 0.003 inch per inch.

Radii: The usual tolerance for radii is $\pm 1/64$ inch although, if necessary, this can be reduced to ± 0.005 inch. Again, for best results and lowest

Extracted from "A Practical Guide to Investment Casting," published by Arwood Precision Casting Corp., New York, N. Y.

costs, allow as generous a radius as possible, and avoid sharp corners. Edge design is shown in *Fig.* 1.

Straightness: When parts are long and thin and a high degree of straightness is required, castings must be mechanically straightened. TABLE 1 lists both the as-cast straightness and what can be expected for various lengths and thicknesses.

Flatness: Mechanical straightening is required to get rid of bow, twist and waviness in typical flat sections. Tolerances are given in TABLE 2. While the values given are for flat rectangular castings, they can be applied to any flat piece.

Concentricity: In general, the larger the outside diameter, the closer to concentric an inside diameter can be cast. In addition, this makes the part easier to straighten mechanically even though the walls may be heavier. TABLE 3 gives the amount of eccentricity that can be expected between the ID and OD of an as-cast part.

Roundness: The ±0.005 inch per inch linear tolerance generally holds for diameters but can be bettered on hollow tubular shapes that can be straightened mechanically after casting.

Angles: As a general rule, angular tolerances finer than ±½ deg should not be called for. Check with the foundry if a closer tolerance is needed. It may be achieved by mechanical straightening.

Parallel Sections: Parts shaped like a tuning fork, with two parallel sections connected at one end, can be cast to within 0.005 inch per inch of parallel. However, if these yoke shapes are very long, mechanical straightening may be required to produce the required tolerance. This tolerance will depend of course, on the alloy used in casting—springy and brittle alloys are hard to work. TABLE 4 shows the actual tolerances that can be achieved.

Holes: The standard dimensional tolerances apply generally to holes. It is possible to cast holes

Table 1—Straightness Tolerances

Length of Part (inch)	Tolerance* As Cast (inch)	Tolerance* Functional (inch)
0 - 2	±0.010	±0.005
2 - 4	±0.015	±0.010
4 - 6	±0.020	±0.010
over 6	±0.030	±0.015

*Total indicator reading.

Table 2—Flatness Tolerances

Length (inch)	As Cast (inch)	Functional (inch)
1	±0.008	±0.004
2	±0.016	±0.006
4	±0.025	±0.010
6	±0.030	±0.015

Table 3—Eccentricity of Holes As Cast

Outside Diam (inch)	Inside Diam (inch)	Runout,* As Cast (inch)	Runout,* Functional (inch)
¾	¼	0.004	0.004
1	½	0.005	0.005
1½	¾	0.008	0.005
2	1	0.010	0.008

*Total indicator reading.

Table 4—Tolerances for Parallel Sections

Distance Between Sections (inch)	Tolerance, As Cast (inch)	Tolerance, Functional (inch)
1/16	±0.003	±0.003
⅛	±0.003	±0.003
¼	±0.003	±0.003
½	±0.005	±0.004
¾	±0.006	±0.004
1	±0.007	±0.005
1½	±0.010	±0.007

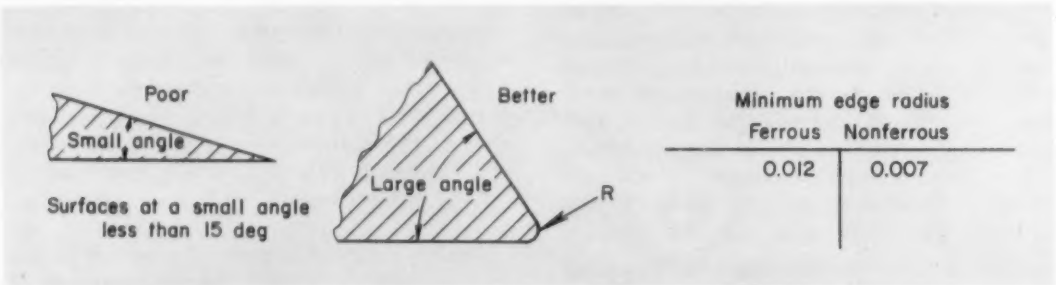


Fig. 1. Recommended edge design. Sharp angles should be avoided.

that have greater diameters inside than at the mouths. Intersecting holes can be cast at lower cost if design allows the cores to be withdrawn.

Design Limits

Size and Weight: Generally dimensions are limited to approximately six by six by fifteen inches and weights to about six pounds for heavy materials and four for light alloys. A check with the foundry will ascertain limits for particular designs.

Minimum Section Thickness: The geometery of the part is, of course, the determining factor, but the following limits are a good starting point:

Limited or tapered areas of low-melting-point alloys can be cast to a thickness of 0.020 inch

Limited or tapered areas of high-melting-point alloys can be cast to a thickness of 0.030 inch

Large areas of low-melting-point alloys can be cast to a thickness of 0.040 inch

Large areas of high-melting-point alloys can be cast to a thickness of 0.060 inch.

Serrations: Sixteen serrations to the inch can be cast in low-melting-point alloys on radii as fine as 0.005 inch. For high-melting-point alloys the figure is eight to the inch, on radii that usually run from 0.005 to 0.010 inch. Dimensions for serrations are shown in *Fig.* 2.

Holes: Practical diameter and depth limits for both through and blind holes are shown in *Fig.* 3.

Surface Finish: This ranges from 125 microinches in ferrous castings to between 63 and 100 microinches rms for nonferrous castings.

Threads: Investment cast threads are the exception rather than the rule. However, investment casting does offer a practical way to produce threads in a hard-to-machine alloy or when an unusual thread design is required. Otherwise, machined threads are preferable—a better fit will be obtained without adding significantly to finishing costs.

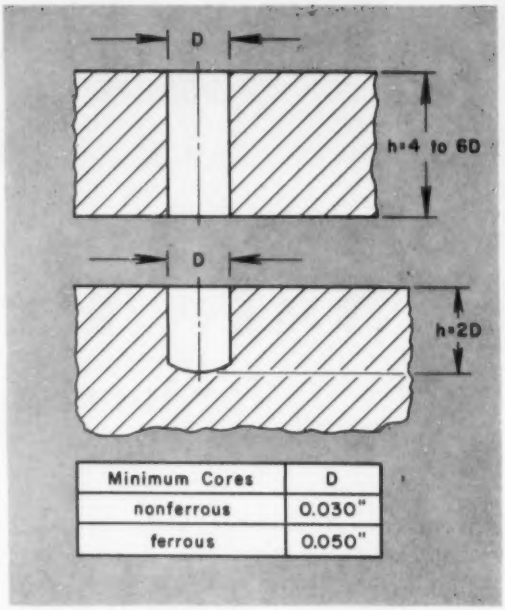


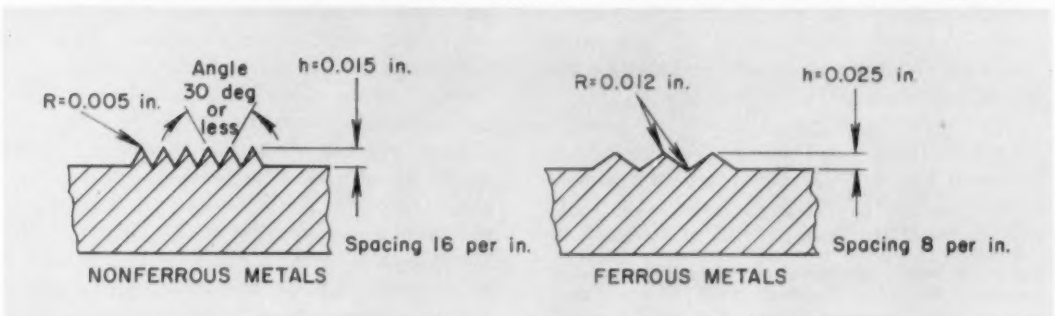
Fig. 3. Hole design. For through holes, the length is from four to six times the diameter. For small blind holes, the maximum depth is twice the diameter. Cores can enter from any face at any angle.

Parting Lines and Gating: For most applications, the small, fine parting line on investment castings is not objectionable. If it is, it can sometimes be moved to another part of the casting. Generally the same thing can be done with gates, although good casting design makes it necessary to locate them in certain areas. Usually they can be shifted to a surface that will ultimately be machined.

Draft: An advantage of investment casting is the ability to produce most parts without any draft allowance. A small amount is desirable for long extended surfaces to facilitate removal from the die.

Fillets: As generous a fillet as can be granted is desirable. A minimum of $\frac{1}{32}$ inch is recommended.

Fig. 2. Minimum dimensions of serrations for best results. Threads are not usually investment cast.



Safe Practices

for inert-gas metal-arc welding

INVESTIGATION of the potential hazards involved in inert-gas metal-arc welding by the American Welding Society has clarified to a large degree exactly which hazards warrant special attention and what safety measures should be used.

Ozone: Ozone is produced by the action of ultraviolet light on oxygen in the air. If welding is carried out in confined spaces, the ozone concentration may increase to harmful levels. No apparent significant hazard exists under conditions of normally good ventilation and welding practice. Tests have shown that the generation of ozone increases at an accelerating rate with increased argon flow. It is important therefore to control the flow of argon to a minimum consistent with a good weld.

Oxides of Nitrogen: Generally the only point where nitrogen dioxide is found in high concentrations is in fumes six inches from the arc. With natural ventilation this concentration is apparently quickly reduced to safe levels, and little hazard exists. However, very high concentrations of nitrogen dioxides have been reported during inert-gas tungsten-arc cutting of stainless steel using a 90 percent nitrogen-10 percent argon mixture as the shielding gas. The amount on nitrogen oxides produced in this case constitutes a definite health hazard and ventilation should be provided for its control. Similarly, high concentrations of nitrogen oxides have been found during experimental use of nitrogen as a shielding gas.

Carbon Dioxide Shielding: There should be no hazard from the inhalation of carbon dioxide or carbon monoxide gas except where the welder works with his head directly in the path of the fumes or where welding is done in a confined space. Under these conditions, ventilation should be provided as described in American Welding Society Standard AWS Z49.1, Par. 8.3 and 8.4.

Trichloroethylene: Experimental evidence has shown that trichloroethylene vapor in the vicinity of an arc is decomposed rapidly—almost instantaneously by radiation from the arc. Although the concentration of trichloroethylene vapors may be too low to be detected by the sense of smell, welding in this area can produce dangerously high concentrations of noxious fumes, including phosgene. This decomposition is accompanied by a very disagreeable odor which may serve as adequate warning. Far greater decomposition is produced by argon than by helium because of the greater radiation intensity. Perchloroethylene decomposes similarly.

Degreasers or other sources of trichloroethylene vapors should be so located that no such vapor reaches the welding area. Welding should be stopped when the odor of decomposition is detected and the source found and controlled.

Radiant Energy

Radiant energy, particularly in the ultraviolet range, presents a far greater intensity during inert-gas metal-arc welding than during shielded metal arc welding (with covered electrodes). This radiation affects the bare skin and unprotected eyes. The intensity of the ultraviolet also causes rapid disintegration of cotton clothing.

Flash goggles, Shade No. 2, with side shields should be worn under the welding helmet or hand shield. The skin should be covered completely to prevent burns or other damage by ultraviolet light. Shirts worn by welders should be dark in color to reduce reflection to the face underneath the helmet. Exposed cotton clothing should not be worn.

Extracted from Recommended Safe Practices for Inert-Gas Metal-Arc Welding, AWS A6.1-58, Published by the American Welding Society, New York.

ASTE news

C. V. Briner as he appeared during a speech in New York City in August, 1946, while he was ASTE president.

In the National Spotlight

1945-46 President of Society Dies

WORD OF THE DEATH Feb. 10 of C. V. ("Clete") Briner, president of the Society in 1945-46, has elicited many expressions of regret and many recollections of the man and his contributions to the ASTE. Briner died in Cleveland at the age of 64.

One of the most fitting tributes came from another past president and one of Briner's closest friends, Ray H. Morris of West Hartford, Conn. In a letter to President George A. Goodwin, Morris wrote about Briner:

"If was my good fortune to have him as a lieutenant when I was in national office, and it was my privilege to work with him when he was president.

"It was a misfortune for ASTE when his health was impaired to the point where he was compelled to withdraw from our activities. What more he might have contributed to the Society, had his health not failed him, is only conjecture, but what he did contribute is a matter of record."

Briner's record is an illustrious one.

He instituted many ASTE "firsts." He was the first chairman of the organizational progress committee and the driving power behind its inception and early operations. This committee was responsible for much of the careful planning whose realization has evolved into the world-recognized organization that is the ASTE today.

During Briner's tenure as national president he implemented, interpreted, and gained membership respect for a new Constitution and Bylaws. The parliamentary structure of the Society was overhauled and modernized and returned to the democratic principles on which it was founded.

He and his team of national officers also managed during the year to gain Society control of this magazine. Despite a War Production Board curtailment of paper allocations, Briner helped THE TOOL ENGINEER maintain continuity of publication.

Under his leadership, the ASTE established a new concept in industrial exhibits with the Cleveland Tool Show in 1946. The show was staged only after an extensive survey had been made of industry's attitude toward and need for such exhibitions. From the survey stemmed the ASTE policy of a show every other year—and, beginning in 1960, every year.

Briner served as a national director from 1940 to 1947, and was second and first vice president before his election to the top post. An ASTE member since 1936, he was a charter member of Cleveland Chapter #3 and chairman from 1940 to 1942.

He was manager of the Gage Div. at the Pipe Machinery Co., Cleveland, at the time of his death. Excerpts from a letter he wrote to Headquarters in 1943 sum up his total engineering background and, incidentally, show up his humanity:

"Asking for my first industrial job takes me back more years than I care to cover. I think you can start it at the old Brightman Mfg. Co. at Shelby, Ohio, running everything from a cutoff lathe to a straightening press.

"I attended Ohio State University where I absorbed a small part of an engineering course; largely through my pores—because if my memory serves me right, both my eyes and ears were usually closed for repairs during classroom hours."

A first lieutenant in World War I, Briner spent five years with the Willard Storage Battery Co. and then 20 years as a sales engineer for Pratt & Whitney. He joined the Pipe Machinery Co. in 1943.

Briner once wrote a paragraph in THE TOOL ENGINEER that expressed succinctly and characteristically his whole approach to life, to his career, and to the ASTE during his active years with it.

"An old salt I knew some years ago," he wrote, "who refused to retire from his active profession at sea despite his three score and ten, summed up his activity with: 'When I rest, I rust.' This homey bit of philosophy hits the tool engineer squarely. When the tool engineer rests, he rusts. Going forever forward is fundamental to his profession."

'Willkommen' Mat Is Out in Milwaukee

MILWAUKEE (pronounced "Gemütlichkeit!") is in territory which at times has been claimed by Spain, France, and Great Britain, and also by Virginia and Ohio, and which has been considered as part of the Indiana, Illinois, Michigan, and Wisconsin territories.

For a few days this month, from April 18 to 22, it's in territory being claimed by the ASTE.

The ASTE's claim is justified in a couple of important ways. While tools may not have made Milwaukee famous, tool and heavy-machinery manufacturing is the city's most important industry—outranking even beer and baseball. And in the Milwaukee area are four thriving ASTE chapters, Racine, Fond du Lac, Madison, and Milwaukee chapter itself. Two of them are pioneers in the Society, Racine #2 and Milwaukee #4.

Sometimes called—in addition to "the beer city" and "the home of the Braves"—the "machine shop of America," Milwaukee leads the world in the manufacture of diesel and gasoline engines, outboard motors, motorcycles, tractors, wheelbarrows, padlocks; leads the nation in the production of work shoes, leather gloves, flour mill equipment.

Seven of the city's many industrial show places are included in the schedule of 11 plant tours for ASTE members during the week-day portion, April 20-22, of the Society's 27th Annual Meeting. Among them, the giant A. O. Smith Co. has pioneered a unique method of fusing glass and steel in making glass-lined tanks, and is a leading maker of auto frames. Harnischfeger Corp. leads in the manufacture of overhead power cranes, the basic lifting muscles of heavy industry. Allis-Chalmers makes tractors, of course, but also electric goods—and it's big enough to use 25,000 power tools throughout its sprawling shops. The Falk Corp. has for 65 years been turning out huge, precision-made marine gears in addition to many other close tolerance items. Wisconsin Motors Corp. and the Louis Allis Co. make engines and motors, lots of them . . .

Such industry, plus the myriad blandishments that are in Milwaukee's make-up—the downtown rivers and the bascule bridges, the landscaped lake shore and the residential bluffs, the good restaurants and the graphic art centers, the oomp-pa-pa of German festive music, the new baseball season, the spirit of "gemütlichkeit," friendliness—furnish a thoroughly absorbing backdrop for a convention.

Most of the convention's official attention during the first two days will be directed toward the indoctrination of new leaders and the recognition of old. The annual Leadership Conference will attempt to inform newly elected chapter chairmen, along with the faculty advisors from student chapters, as to the most effective techniques for proper administration. Alternate delegates will be the new chapter first vice chairmen.

Honor Award Winners Named

The list of luminaries to be saluted at the Honor Awards Dinner, in the Crystal Ballroom of the Schroeder on Saturday evening, April 18, reads like a Who's Who in American industry and education. George Romney, president and chairman of American Motors Corp., will receive the Society's Progress Award. T. Bert Carpenter, past president of the ASTE and president of the Bert Carpenter Co., Birmingham, Mich., will get the Joseph A. Siegel Memorial Award for his contributions as "a true tool engineer, continuously offering valued service and wise counsel at all levels of Society operations." Dr. Alfred O. Schmidt, chief research engineer, Kearney & Trecker Corp., will be given the Gold Medal for his significant work in improv-

Banquet Speaker Lives His Script

Col. John P. Taylor intends to speak with authority when he takes his ASTE audience "Adventuring in Space" at the annual banquet.

In a letter to Convention Manager Richard J. Bacik at Headquarters, Taylor wrote: "I recently volunteered for a zero-g ride in order to express from personal conviction what it feels like to float weightlessly in the wild blue yonder. Will try to undergo a couple of other space orientation experiments prior to the presentation in order to give a little more personal touch to the speech."

William J. Grede
Milwaukee Day Speaker

Col. John P. Taylor
Banquet Speaker

ing machine tool design, tool materials, and cutting fluid applications. His writings have appeared in numerous engineering journals. Jacob J. Jaeger, just named executive vice president of Pratt & Whitney Co., West Hartford, Conn., will be honored with the ASTE Engineering Citation for his leadership in the field of industrial automation. Prof. Kenneth J. Trigger, mechanical engineering department of the University of Illinois, will receive the Research Medal for his findings in physical metallurgy, metal cutting, and machinability. The Education Award will go to Dr. Mark Ellingson, president of the Rochester Institute of Technology, for sponsorship of cooperative tool engineering courses at junior and senior college levels.

Winding up the Honor Awards program will be the third annual Eli Whitney Memorial Lecture, by Swan E. Bergstrom, president of The Cincinnati Milling Machine Co. Bergstrom will talk on "The History of Metal Cutting."

But the real mood-setter for the convention will be the Sunday evening "Willkommen," the Milwaukee's Host Committee's welcome buffet for visiting ASTE members and their wives. L. A. Wacker is general chairman of the host group. Other officers are George L. Riordan, vice chairman; Keith Entrekin, secretary; Stephen Pohlhammer, Division "A" coordinator; Joseph Mundbrot, Division "B" coordinator; and Ralph Perlewitz, heading Division "C."

Talks on Taxes and Space

Two guest speakers have been scheduled for appearance at the Milwaukee Day Luncheon and the National Membership Meeting and Banquet.

William J. Grede, president of Grede Foundries, Inc., will highlight the Monday luncheon with his talk on "Profits, Taxes and Freedom." Grede employs nearly 1000 people in his seven foundries, which are located in Wisconsin, Michigan and Indiana, so he is well qualified to expound on this subject. He received the McFadden Gold Medal from the American Foundrymen's Society in 1953. Included among his many other activities is his service as president of the Employers Association of Milwaukee and the Wisconsin Manufacturers Association. He is also director and chairman of the executive committee of the J. I. Case Co., director of the Federal Reserve Bank of Chicago, chairman of the board of trustees of Carroll College, and president of Milwaukee's YMCA. Grede's interest in the YMCA extends also to the state, national and international level.

Two days later at the banquet, Col. John P. Taylor, assistant chief of the aircraft laboratory at the Wright Air Development Center, will speak on a subject which follows quite naturally after a discussion of profits, taxes and freedom—space. To avoid all the earthbound problems mentioned in the earlier talk, Taylor says simply, "Let's Go Adventuring in Space." Both a mechanical and an electrical engineer, Taylor served at the highest headquarters level in the Army Air Corps during World War II. Later he was with the Joint Chiefs of Staff, and acted as executive secretary of the Interdepartmental Committee on Scientific Research and Development, in which job he reported directly to President Truman. The colonel was also a staff member of the Office of the Secretary of Defense and a charter member of the Research and Development Board. Several chief scientists of the Air Force and Gen. Jimmy Doolittle have recently availed themselves of his services.

Technical Sessions, Tours, Teas

The schedule of 27 technical papers—matching in number the years of the Society's existence—should include one of special interest to each delegate. And when he is not absorbing a discussion on "Developing Creativity in Engineering" or "Zero Point One," the Milwaukee visitor can board a bus and head for one of that city's many industrial plants. The dozen tours are scheduled Monday through Wednesday, four each day.

Ah, but amid all this hubbub of technical sessions, plant tours and the like, the voice of the Ladies' Committee is heard beckoning to ASTE wives. Get-acquainted teas, fashion shows and anything else you can think of to nicely fill those hours when the husband is busy becoming a leader or puzzling over "Current Developments in Numerically Controlled Die Sinking Machines" will be offered the delegates' wives. Just as the male half of the ASTE convention pair will come away from the Annual Meeting knowing the latest technical advances in every phase of tool engineering, so too will the female half learn of the latest fashions from New York and of the wife of that new member from Schuylkill Valley.

daily schedule of events

Milwaukee Convention

location:

All events in Schroeder Hotel, Milwaukee, Wis.

dates:

Sat., April 18, through Wed., April 22.

registration:

Fourth floor foyer, Schroeder Hotel, at these hours:
Sunday, 2 to 8 p.m.
Monday, 8 a.m. to 8 p.m.
Tuesday, 8 a.m. to 5 p.m.
Wednesday, 8 a.m. to 4 p.m.

An ASTE Center, located in the registration area, will be open during registration hours. Complete information on convention activities and literature on all phases of ASTE operation will be available.

ASTE's 27th Annual Meeting will be held in co-operation with these host chapters:
Racine No. 2
Milwaukee No. 4
Fond du Lac No. 45
Madison No. 75

saturday april 18

leadership conference

A two-day workshop session for ASTE National Delegates—designed especially to illustrate effective techniques for the proper administration of an ASTE chapter.
Begins Saturday at 7:30 a.m. with a "Welcome Breakfast" at the East Room, Schroeder.

Workshop sessions like this one in 1958 will dominate the Leadership Conference agenda this year.

Honor Awards Dinner
and
Third Annual Eli Whitney Memorial Lecture

7:30 p.m. Crystal Ballroom

Announcement and presentation of six ASTE National Honor Awards

Progress Award: **George Romney**
President and Chairman, American Motors Corp.

Joseph A. Siegel Memorial Award: **T. Bert Carpenter**
ASTE Past President, President, Bert Carpenter Co., Birmingham, Michigan

Gold Medal: **Dr. Alfred O. Schmidt**
Chief Research Engineer, Kearney & Trecker Corp., Milwaukee

Engineering Citation: **Jacob J. Jaeger**
Vice President and Chief Engineer, Pratt & Whitney Co.
West Hartford, Conn.

Research Medal: **Prof. Kenneth J. Trigger**
Mechanical Engineering Dept., University of Illinois

Education Award: **Dr. Mark Ellingson**
President, Rochester Institute of Technology

Eli Whitney Lecture, "The History of Metal Cutting" by
Swan E. Bergstrom
President, The Cincinnati Milling Machine Co.

Tickets $4.00

sunday april 19

'Willkommen'

7 p.m. Crystal Ballroom

The Host Committee's welcome to all convention-goers, in the old Milwaukee manner.
Includes a buffet supper, refreshments, entertainment and dancing.
Tickets are complimentary, but advance reservations are necessary

monday april 20

ASTE House of Delegates

(Closed Session)

9 a.m. to 5 p.m. Lorraine Room

Meeting will be convened by President George A. Goodwin.
Election of National Board of Directors for 1959-60 term
(taking office in October, 1959).

Tool Engineers and Management

9:30 a.m. Empire Room

"When Does an Engineer Become a Manager?" by Dr. Russell L. Moberly, management consultant.

"For Better Understanding—of Your Business by Your People," by Thomas E. Wood, consultant, Communications Dept., Edwin Shields Hewitt and Associates.

Chairman: I. F. Herbes, works manager, Allen Bradley Co.

It'll Pay to Attend
* Planning for Profit *

THERE'S NO such thing as a GAP—"guaranteed annual profit"—for manufacturing men.

But the ASTE's five-session seminar on the subject is bound to profit those who attend. "Planning for Profit," one of the Society's 1959 series of Creative Manufacturing seminars, is designed to present the latest and best information available on the factors that influence manufacturing costs, and to offer better means of controlling these costs.

Registration is at 9 a.m. Monday. Carl S. Abbott, president of J. N. Fauver Co., Inc., is general seminar chairman.

Seminar starts at 10 a.m. and stretches over two days, April 20-21. Registration is limited to 100, in advance. Fees are $50 for ASTE members, $75 for nonmembers. (Nonmembers may apply the difference in fee to ASTE membership!) Fee includes a bound volume of the seminar papers, two luncheons, the ASTE Annual Banquet, and the privilege of attending all other technical sessions.

*denotes sessions of "Planning for Profit" seminar

Planning for Profit — I

10 a.m. *

"Trends in Tool Engineering—Controlling Manufacturing Costs," by T. W. Black, senior associate editor, THE TOOL ENGINEER.

10:30 a.m. *

"Control of Overhead Costs," by Galen M. Taylor, vice president—manufacturing, Koehring Co.

11 a.m.

Discussion period. *

Chairman: Harry Gute, general manager and owner, The Gute Co.

Milwaukee Day Luncheon

A Salute to Milwaukee Area Industry

12:30 p.m. Schroeder Hotel

Toastmaster: L. A. Wacker
General Chairman, Milwaukee Host Committee

ASTE Welcome: George A. Goodwin
President of ASTE

Keynote Speech: "Profits, Taxes and Freedom"
by William J. Grede
President, Grede Foundries, Inc.

Tickets $4.00

Planning for Profit — II

2:30 p.m. *

"Capital Costs and You," by Carl M. Beach, executive vice president, the Heald Machine Co.

3 p.m. *

"Control of Research and Development Costs," by H. Dale Long, president, Scully-Jones & Co.

Tool Engineers and Education

3 p.m. Empire Room

"Designs for Successful Living," by Dr. Harold S. Vincent, Superintendent of Schools, Milwaukee Public Schools.

"The Tool Engineer and the Tools of Yesterday," by Eugene S. Ferguson, curator, Mechanical and Civil Engineering, U. S. National Museum, Smithsonian Institution.

Chairman: Benjamin Elliott, chairman of mechanical engineering, University of Wisconsin.

3:30 p.m. *

Coffee break.

4 p.m. *

"Key Factors in Material Cost Control," by James B. Purdy, technical liaison, Department of Economics, Battelle Memorial Institute.

4:30 p.m. *

Discussion period.

Chairman: D. P. Welles, Jr., director of research, Besly-Welles Corp.

Planning for Profit — III

8 p.m. *

Cost Control in Quantity Production," by Robert L. Witsche, general Supervisor, Mechanical Engineering Research, International Harvester Co.

8:30 p.m. *

"Cost Control as Exercised by a Machine Tool Manufacturer," by Erwin J. Kaiser, staff vice president—manufacturing, Giddings & Lewis Machine Tool Co.

Tool Engineers and Statistics

8:30 p.m. Lorraine Room

"Tooling Experiments Using Statistics," by Donald F. Eary, supervisor of die engineering design, Industrial Engineering Dept., General Motors Institute.

Chairman: Gordon F. Leitner, vice president, Cleaver-Brooks Products, Inc.

9 p.m. *

"Control of Labor Costs," by Arthur F. Gould, head of industrial engineering department, Lehigh University.

9:30 p.m. *

Discussion period.

Chairman: Norman D. Rice, vice president—operations, Inland Steel Products.

plant tours for monday

Tour #1—9 a.m. Allis-Chalmers Mfg. Co.

Limit 100 visitors. No cameras permitted. In use throughout the shops are 25,000 power tools ranging in size from the giant 40-foot boring mill to small precision machines.

Tour #2A—1 p.m. The Louis Allis Co.

Limit 50 visitors. Specialists in adjustable speed drives and electric motors up to 1250 hp.

Tour #2B—1:30 p.m. (This is a repeat of Tour #2A.)

Tour #3—1 p.m. American Motors Corp.

Limit 100 visitors. No cameras permitted. Automobile body plant featuring "Monobuilt" unit, a one-piece unit construction auto frame and body.

tuesday april 21

Annual Meeting
of
ASTE Board of Directors

9 a.m. to 5 p.m. Crystal Ballroom

ALL MEMBERS WELCOME TO ATTEND

Planning for Profit — IV

9 a.m. *

"Cost Control Through Design," by Richard T. Studer, administrative engineer, the Warner & Swasey Co.

9:30 a.m. *

"The Industrial Engineer's Responsibility for Design Cost Control," by Lad J. Bayer, chief industrial engineer, the Warner & Swasey Co.

Tool Engineers and Metal Cutting

9:30 a.m. Lorraine Room

"A New Approach to Machinability Determinations," by Horace A. Frommelt, director, Metal Removal Center, Spring Garden Institute.

"Zero Point One," by Albert M. Dexter, director of metrology, Pratt & Whitney Co., Inc.

Chairman: John P. Bradish, director, mechanical engineering, Marquette University.

10 a.m. *

Coffee break.

10:30 a.m. *

"Management Controls Costs" (special audience participation session).
Chairman: James G. Van Vleet, director of engineering, University of Wisconsin.

Planning for Profit — V

2:30 p.m. *

Panel—all speakers will participate in the general discussion.

ASTE-ASME Joint Session

3 p.m. Lorraine Room

"Developing Creativity in Engineering," by D. G. Taylor, staff engineer, Minneapolis-Honeywell Regulator Co.; and R. C. Jordan, head of the department of mechanical engineering, University of Minnesota.

"Human Factors Responsibilities of Design Engineers," by Joseph L. Seminara, human factors specialist, Human Factors Unit, Fletman Research and Engineering Laboratories, Picatinny Arsenal; and G. A. Peters, consultant.

"The Potential Machine Designer," by J. F. Downie Smith, vice president, research and development, Carrier Corp.

Chairman: J. R. Brand, assistant director of Mechanical Development Lab., E. I. DuPont de Nemours & Co., Inc.

4 p.m. *

"Recapitulation," by George DeGroat, associate editor, *American Machinist* magazine, and author of ASTE handbook, *Tooling for Metal Powder Parts.*
Chairman: Alfon D. Mathison, Milwaukee Institute of Technology.

ASTE's Annual Installation Banquet and National Membership Meeting

6:30 p. m. — Crystal Ballroom

Tuesday, April 21 — Schroeder Hotel

Toastmaster: Harry E. Conrad, Executive Secretary, ASTE

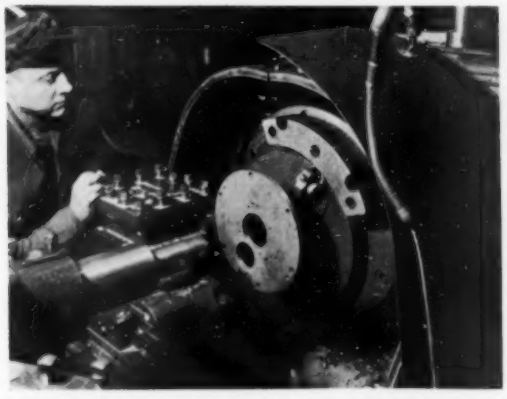
Installation of newly elected officers
by ASTE President, George A. Goodwin

Speaker: Col. John P. Taylor, Assistant Chief of
Aircraft Laboratory, Wright Air Development Center, Dayton, Ohio

Topic: "Let's Go Adventuring in Space"

Entertainment: Francis Miller Trio

Dress optional — Tickets $6.00



An example of the tooling that will be seen by ASTE members during the Annual Meeting plant tours is this machine at the Falk Corp. (Plant Tour #7.) A three-spindle head has been added to a standard lathe. Pop-out tools permit boring on one side of part, counterboring other without changing setup.

plant tours for tuesday

Tour #4—9 a.m. Harnischfeger Corp.

Limit 100 visitors. Operations in making power shovels, trucks and overhead cranes, soil stabilizers, welding equipment.

Tour #5—9 a.m. A. O. Smith Corp.

Limit 100 visitors. Must be U. S. citizens. No cameras permitted. Tour includes research dept., auto frame line and welded line-pipe operations.

Tour #6—1 p.m. (This is a repeat of Tour #3)

Tour #7—1 p.m. The Falk Corp.

Limit 100 visitors. Must be U. S. citizens. No cameras permitted. Tour visits steel foundry, open hearth foundry capable of pouring a 75-ton casting, machine shop showing multiple-purpose tools and machines.

wednesday april 22

Tool Engineers and Shop Operations

9 a.m. Crystal Ballroom

"Welding of Tool Steels," by John J. Chyle, director of welding research, A. O. Smith Corp.

"Power Measurements in Milling," by Ivar Bendixen, Technical University, Copenhagen, Denmark.

Chairman: K. F. Kummer, chairman, mechanical engineering, Milwaukee School of Engineering.

Tool Engineers and Machine Tools

9:30 a.m. Lorraine Room

"Machine Selection and Application in a Large Industrial Plant," by Richard Thuma, superintendent, tools and maintenance dept., Industries Group, Allis-Chalmers Mfg. Co.

"Current Development in Numerically Controlled Die Sinking Machines," by Darwin Bingham, Jr., supervisor, numerical control programming section, G & L and Hypro Div., Giddings & Lewis Machine Tool Co.

Chairman: Charles Gorton, vice president, George Gorton Machine Co.

Tool Engineers and New Developments

2 p.m. Crystal Ballroom

"Design Problems with Precision Elephant Type Machine Tools," by Walter McCann, chief engineer, G & L and Hypro Div., Giddings & Lewis Machine Tool Co.

"Simplified and More Accurate Model Reproduction with RTV Silicone Rubber," by Donald E. Dutt, senior engineer tool-development, manufacturing process development laboratory; and Robert Treat, Jr., rubber specialist, Silicone Products Dept., General Electric Co.

Chairman: Morris Hutchens, vice president-engineering, Kearney & Trecker Corp.

plant tours for wednesday

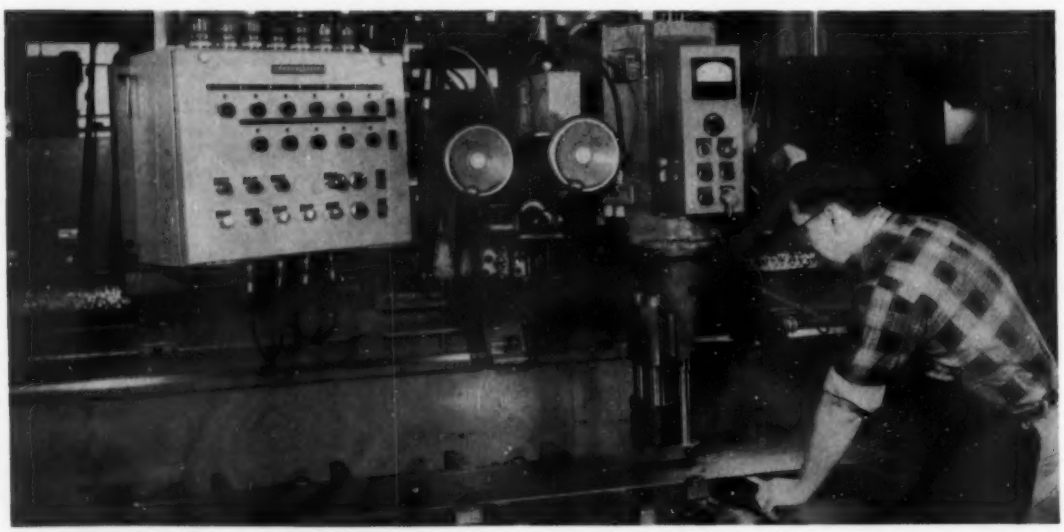
Tour #8—9 a.m. (This is a repeat of Tour #5)

Tour #9—9 a.m. Wisconsin Motors Corp.

Limit 100 visitors. Manufacturing operations used in producing heavy-duty, air-cooled engines from 3 to 36 hp; one of country's top producers of gasoline engines.

Tour #10—1 p.m. (This is a repeat of Tour #1)

Tour #11—1 p.m. (This is a repeat of Tour #4)



Touring ASTE members will see several applications of numerical control in Milwaukee plants. This drilling operation is at A. O. Smith Corp. (Plant Tours #5 and #8.) Location of drilling head is controlled by punched tape. The special Morton drilling machine is used in the preparation of master blanks for frame side rails. Control panel is used to set up hole location when no tape is available.

Ladies Activities Committee for the 1959 convention consists of (left to right) Mrs. Richard O. (Inez) Bell; Mrs. Keith D. (Eunice) Entrekin; Mrs. George L. (Dorothy) Riordan; Mrs. Stephen (Alice) Pohlhammer; Mrs. Joseph (Ann) Mundbrot; Mrs. L. A. (Beverly) Wacker, chairman; and Mrs. Ralph L. (Ann) Perlewitz. Mrs. Entrekin will maintain hospitality room.

LADIES' ACTIVITIES

Hospitality room and lounge will be maintained by the Milwaukee Ladies' Activities Committee, fourth floor, Hotel Schroeder.

Registration for the Convention (no charge for ladies) at the ASTE registration area on the fourth floor foyer of the Schroeder.

sunday

7 p.m.

"Willkommen" in palm garden setting.
Buffet supper, entertainment and dancing.
No charge.
Reservations necessary.

monday

10:15 a.m. to 5 p.m.

All-day tour of Milwaukee's show places.
Luncheon at Alpine Village.
Tickets $3.75

tuesday

11:30 a.m. to 4 p.m.

Luncheon and shopping at Capitol Court
Suburban Shopping Area
Tickets $3.50

wednesday

11 a.m.

English Room, 5th floor

"Auf Wiedersehen" breakfast.
Dramatic presentation,
"For Women! By Women! About Women!
Tickets $2.50

Engineering

THE STEREOTYPE image of the typical British student wearing a flowing academic gown and mortarboard and attending either Oxford or Cambridge is slowly giving way to that of the young man in work clothes and lunch pail who divides his time between the shop and the classroom. The reason for this image-breaking occurrence is the upsurge of engineering education in the British Isles.

With all the concern presently being shown in the United States toward what might be considered the ideal curriculum for the engineer, and toward the supply and demand for engineers, I was interested in discussing some of these same problems with engineering educators in Britain as I traveled abroad recently. It would appear from my investigation of the programs for training engineers, and from talks with responsible people, that England is also very conscious of its shortage of production engineers and of its need for providing top-level training for future engineers and technologists.

So urgent is Britain's need and so concerned are British educators over maintaining their traditionally high educational standards in their engineering programs, that a closer look at some of their new curricula might help us to understand how they are tackling their problems.

There is a shortage of technically trained men in all production areas. There is a shortage of production personnel with engineering background who can exercise judgment and control on a high technical level and, at the same time, function with administrative skill at the management level. The older systems of apprentice training are no longer attractive to young people; neither does there seem to be sufficient initiative on the part of parents for placing their youngsters in this type of program.

The economic relationships which at one time prevailed among the unskilled, the semiskilled and the skilled personnel in an industrial plant no longer exist. It is not unusual to learn that a production worker on the line takes home a much bigger pay envelope than does the electrician, patternmaker, toolmaker, or engineer.

Family relationships and stability have also undergone changes. With faster communications and transportation, young people represent a freer and more mobile part of society. It is more difficult for them to accept the economic and other restrictions which usually accompany the tedious requirements in long-term engineering training programs. These, along with many other factors, are the elements which have arisen and have caused the decline, up till now, of those anxious to study engineering.

Old Traditions and New Departures

To meet the challenge and satisfy the need for engineers with production and manufacturing know-how, new approaches to technical training are being taken in Britain. Of course, British education still clings dearly to its tradition. If a child wishes to continue his education beyond the secondary school he first must pass a written examination. The tender age at which this exam is administered has proved itself an easy target for critics of the British educational system.

Much controversy persists regarding the "eleven plus examination." Anyone who has reached his 11th year and who has a desire to take the test may do so. In the majority of the cases, however, those who sit for the exam have been recommended by their teachers. Two processes of elimination confront the student. One is meeting the score required to pass. The other is the available number of openings in the schools. At the most, only 20 percent of those who compete are eventually placed in a grammar school, where they will stay until they reach 16 or 18. That this examination should be given at such a young age and that it should have such a lasting effect on the boy's life is a much questioned practice.

For the average British schoolboy, his education terminates in the secondary modern school at 15 and in the secondary technical school at 16. Further education in engineering is obtained by pursuing advanced programs. Typical of these are the Ordinary National Certificate, the Ordinary National Diploma and the Diploma in Technology.

Students entering a program for the ONC in production engineering generally come in at the age of 16. One additional year of study is necessary for students who leave the secondary modern school at 15. The ONC is a three-year program, but because most of the students maintain regular jobs during the day and attend classes at night, the program is seldom completed in the minimum time of three years. It is understood that some algebra and ele-

Education in Britain

By **Frederick Preator***
Head, Tool Engineering Dept.
Utah State University
Logan, Utah

mentary trigonometry have already been taken by the boy before he enters the course. Analytical geometry and calculus, along with one year of physics, electrical engineering and applied mechanics, will follow. Courses in liberal arts or business are not usually pursued because time is so limited. However, one should not overlook the thoroughness with which mathematics, English, history, and geography are treated at the secondary level.

OND and Dip Tech Plans Favored

The Ordinary National Diploma is considered a much greater achievement than the ONC. Students are accepted only if they have completed the ONC, or have received a General Certificate in Education from their grammar school in upper division mathematics and physics courses. This program in production, electrical or mechanical engineering is frequently referred to as the "day release program." Students enter into this plan on recommendations from their place of full-time employment, and their previous school record. A schedule is arranged whereby the student can, still receiving full wages, take one or two days a week off so that he might attend classes. The same mathematics and science courses are required as with the ONC, plus additional courses which include a year of chemistry. A National Diploma in Production Engineering awarded by the Institution of Production Engineers is received upon completion of this program.

There is much stress presently being put on the Diploma in Technology plan, or sandwich course, as it is often spoken of. Students are admitted into the college only after an examination of their record, an interview and pending the number of openings available. Students who obtained the OND with high marks and students who have passed the GCE exams in scientific upper-division courses are Dip Tech material. This program, as the word sandwich might imply, is a cooperative program between school and industry. It is designed to combine the advantages of full-time study and works training in production engineering. The courses provide a sound basis in fundamental science and mathematics. The intense study of production engineering is supplemented by related courses in applied science. Attendance at the college requires six months of full-time study and two evenings each week during the remaining six months while serving in industry. Related studies in economics and human relations are provided, and students are encouraged to pursue the liberal arts. Such classes are not recognized as any part of the engineering curriculum; they are carried on the student's record only as endorsements.

U. S. Encourages Study of Humanities

This is where the British and American engineering curricula come to a parting of the ways. In the United States the first two years of a four-year plan offer the student opportunity to orient himself in the humanities, provided, of course, he enters college with an already sound knowledge of basic math and science. Most educators believe that English, speech, history, and other nontechnical subjects will broaden the engineering student's background and make him a more well-rounded person. This is true only in the four-year curriculum; the same does not hold for the two-year plan. And since most British engineering curricula are of this relatively short period, it is understandable that most of the attention is centered on the purely technical subjects.

It should be kept in mind that this whole report deals with British engineering education in general. At present there is no comparison between the firm foothold the special field of tool engineering has gained in the United States and its beginning stages now existing in Britain. In fact, no specific course in tool engineering is being offered at all overseas.

One can only conclude that the British requirements for recognition in the engineering field are neither as intense nor as time-consuming as the American degree program. But now that the problem has been rooted out, steps have already been taken to remedy it. The University of Birmingham and several other colleges of technology have set up excellent facilities for training production engineers in every phase of this type of work. It is also interesting to note that full professional recognition in engineering is a function of the separate professional engineering societies.

The respect which once accompanied the title engineer is swiftly being restored in the minds of the British people, especially the youngsters who might someday be bearing that title.

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*Senior member ASTE Salt Lake City chapter.

Philadelphia grouping exemplifies the informal atmosphere that reigns at ASTE seminars as a result of limited advance registration, high-level programs—and well-timed coffee breaks such as this one. Left to right are Francis McCarthy, service engineer, Alden Supply Co.; Kempton Roll, executive secretary, Metal Powder Industries Federation; Campbell Pittsinger, seminar chairman; Prof. Arthur Gould of Lehigh University, chairman, ASTE Education Committee; and Peter V. Schneider, IBM metallurgist.

Progress Report on

A PROGRESS REPORT on the ASTE's "creative manufacturing seminars" has been issued at the midway mark of the 1959 series by National Education Director Gilbert E. Seeley. The seminars are sponsored by the National Education Committee.

Although attendance at the six seminars thus far presented has varied from small (and informally beneficial!) to sizeable, it has consistently been gratifying from the viewpoint of the quality and enthusiasm of the registrants, Seeley said.

At the Feb. 4 debut of the "Tooling for Metal Powder Parts" seminar program in Philadelphia, for instance, Seeley read off an impressive list of preregistrants during the speakers' briefing session the night before the seminar. It sounded like a blue book of metal powder industry leaders.

"Maybe we should change places with the 'students,'" commented one of the speakers, an expert on powder metallurgy in his own right.

Seeley said the same high-caliber turnout was the outstanding aspect of other seminars in San Francisco and Los Angeles (plastic tooling); in Chicago (a repeat of the powder metallurgy seminar); in Hartford (a two-day "Analysis of Metal-Cutting Methods"); and in Detroit (numerical controls).

In the Detroit audience of 150 were at least a score of company presidents and vice presidents, and a preponderance of executive-level representatives from 11 states and two provinces in Canada.

Coming up this month and next are four more seminars. The schedule:

April 9-10—"Analysis of Metal-Cutting Methods." Benjamin Franklin Hotel, Philadelphia.

April 20-21—"Planning for Profit." Schroeder Hotel, Milwaukee; in conjunction with ASTE Annual Meeting. (See Page 146 for details.)

April 24 —"Tooling for Metal Powder Parts." Sheraton-Palace Hotel, San Francisco.

May 6 —"Optical Tooling and Gaging." Chase Park Plaza Hotel, St. Louis.

The single-day seminars consist of five technical papers; the two-day seminars on metal cutting have 12 papers. All feature open-forum discussion periods and an unequaled opportunity for registrants to ask questions and get answers from people who know the latest in the various fields.

Metal Powder Experts Speak

Seeley said his praise of the quality of seminar audiences was not meant to detract from the stature of the speakers and panel members. At the Philadelphia session, for example, which was cosponsored by the Metal Powder Industries Federation and ASTE Philadelphia Chapter, the agenda included these leaders from the metal powder industry:

Roy Jamison, sales engineering manager for Hoeganaes Sponge Iron Corp., who spoke on ferrous metals; and M. H. Reid of New Jersey Zinc Co.'s market development, on nonferrous metals.

Peter V. Schneider, project metallurgist for IBM, Endicott, N.Y., an ASM chairman who described prototype, pilot and production tooling features of metal powder parts.

Harold Harrison, plant metallurgist for Pressmet, speaking on properties and tolerances.

Samuel Bradbury, III, production specialist with F. J. Stokes Co., who discussed compacting and tooling systems for powder parts.

Signing in with Convention Bureau employee at Philadelphia seminar on powder metallurgy parts are (left to right) Francis J. McCarthy of the Philadelphia ASTE chapter; Charles W. Stoddard, N. C. Thompson, D. W. Darrone and Larry C. Miner, all from the Allen Tool Co., Syracuse, N. Y. All sessions were held at the Benjamin Franklin Hotel.

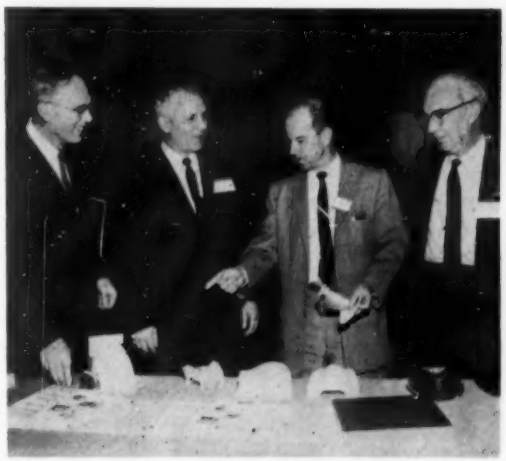
S. S. Connor, vice president, Bound Brook Oil-Less Bearing Co.; R. B. Bouman, general manager, Reese Metal Products Co., Lancaster, Pa.; and K. M. Gleszer, president, Dixon Sintaloy, Inc.

Fees for the one-day seminars are $30 for ASTE members, $45 for nonmembers. They run $50 for members, $75 for nonmembers for the two-day programs. The fee includes all sessions, all luncheons and coffee breaks, and technical papers and research reports.

ASTE Seminars

Kempton Roll, executive secretary of the cosponsoring federation and also an ASTE member, discussed the modern development of metal powder parts from first commercial utilization as self-lubricating bearings in refrigerators to the present almost unlimited range of parts being made by 70 companies in the United States. He analyzed the current state of the powder metallurgy business by citing figures on consumption of iron powder, the bellwether of the industry. In 1958, he said, 22,000 tons of iron powder were used—down from the peak consumption of 32,000 tons in 1956 but still significantly high. About 47 percent of this tonnage went into metal powder parts, he noted.

Serving as chairman at Philadelphia was Campbell Pittsinger, general toolroom foreman at SKF Industries and past chairman of Philadelphia Chapter 15. On the open-forum panel were Roll and George G. Karian, metallurgist for Alan Wood Steel Co., as moderators; J. R. Powders, general manager of Supermet Div., Globe Industries, Dayton, Ohio;



Examining plastic tooling display at Los Angeles seminar are (left to right) G. J. Walkey of Lockheed Aircraft Corp., Burbank; N. M. Hastings of Hastings Plastics, Inc., Santa Monica; B. J. Bryan of Furane Plastics; and Albert Stangebye, Norris-Thermodore.

Members in the News

William L. Dolle, president of the Lodge & Shipley Co., receives a plaque from Secretary of the Army Wilber M. Brucker (left) at the first anniversary observation in Washington of this country's first successful satellite launching. Dolle's company, among a handful of firms honored by the Army, was cited for development of the Flotum process and actual production of the nose cone for Explorer I. Dolle is a Cincinnati chapter member.

Two ASTE members at West Hartford, Conn., one of whom will be the 1959 recipient of the Society's Engineering Citation at the Honor Awards Dinner in Milwaukee April 18, have been promoted at Pratt & Whitney Co. JACOB J. JAEGER, the Honor Award winner, was named executive vice president, and EDWARD J. SHAGES, formerly vice president and manager of the cutting tool and gage division, was named vice president in charge of manufacturing for all operations. Both are members of Hartford chapter. Jaeger, who had been vice president in charge of engineering for four years prior to his promotion, has been associated with Pratt & Whitney since 1940 and was elected a director of the company in 1956. In his new capacity, he will be responsible for all sales and manufacturing operations. Shages started as an apprentice in 1929.

Cincinnati chapter member WALTER DEROCHE has been made general manager of ABCO Tool and Die Co., Madeira, Ohio. Formerly associated with the Hamilton Tool Co., DeRoche has been sales manager and chief tool engineer of ABCO for seven years.

The Metallurgical Products Div. of GE at Detroit has announced the appointment of H. J. SIEKMANN to manager of market development and research. The Detroit chapter member becomes responsible for product planning, market research and sales development of new carbide products. He was formerly manager of applied mechanics engineering . . . WILLIAM P. HENKEL, Cincinnati chapter, has been named Dayton district manager of Latrobe Steel Co., Latrobe, Pa. He has been an Ohio sales staff member for five years, following seven years' work in the laboratory of the Latrobe home office. . . . Board of directors of the Powder Metallurgy Parts Manufacturers Association has re-elected KENNETH M. GLESZER, Fairfield County chapter, as president of the national group. Gleszer is president of Dixon Sintaloy, Inc., Stamford, Conn. . . . JACK R. HENDERSON, Peoria chapter, has been named factory and sales service representative for the Madison Industries' line of boring and reaming tools. He has headed his own sales firm, the Henderson Tool Co., for the past four years. . . . HOWARD B. UPHAM, Cincinnati, has been named district manager in the field sales force of Pratt & Whitney Co.

DeRoche

Siekmann

Upham

Associated with an expansion program at Lahr Machine & Tool Corp., Toledo, Ohio, is HERBERT TIGGES, past president both of the ASTE and of the National Machine Tool Builders Association. Tigges went to Lahr from his position as executive vice president of Baker Brothers, Inc., Toledo. As a result of the Lahr expansion program, a new division called Lahr-Tandco is offering a new concept of a building block, standard multi-operation unit machine for drilling, reaming, boring and tapping both in the vertical and horizontal types.

Among those ASTE members who have recently become registered professional engineers: HERBERT A. KLASEK and JAMES A. MCNEELY, both of St. Louis chapter; HARRY BERINGER and H. F. KINKEL, JR., both of Long Island chapter. McNeely is a member of St. Louis chapter's education committee.

GEORGE N. POPHAM of the Gorham Tool Co., Detroit, has been elected president of the Cutting Tool Manufacturers Association. Chosen a member of the group's board of directors for a three-year term was ROBERT S. FOWLER, vice president of Wheel Trueing Co. Both are Detroit chapter members. KENNETH R. BEARDSLEE, a member of the ASTE's Research Fund Committee, was elected vice president of the cutting tool association. He is general manager, Metallurgical Products Div., GE.

chapter news and views

Program Chairman Elected to Head E. Texas Chapter

EAST TEXAS—Members of Chapter #126 backed their nominating committee's selection of the program chairman to be the 1959-60 chapter chairman in an election night meeting at the Longview Airport Feb. 12. Carl W. Stone, elevated to the chairmanship, is with the Lone Star Steel Co.

Other officers elected were: Paul J. Joy, first vice chairman; Eldon J. Mays, second vice chairman; Louis C. Kral, third vice chairman; Don Peek, secretary; and Dan Siddall, Jr., treasurer.

Swelling an over 50 percent attendance of home chapter members, and materially bolstering the morale of East Texas, was a delegation from the big-brother North Texas chapter. In addition to National Director Irving H. Buck, who spoke on ASTE progress and long-range planning, the group included new Chairman Ben Harris; first Vice Chairman Hal R. Montgomery; immediate Past Chairman Lee Edmondson; and Membership Chairman Mansel Duffel.

The most absorbing portion of the program, however, was the talk on "Tooling the B-58" by another member of North Texas chapter, Ralph Fuhrer. As chief manufacturing engineer for the mammoth Convair plant in Fort Worth, Fuhrer supervises some 3000 tool engineering personnel. Using slides and spectacular test-flight movies to supplement his talk, he described the ingenious metal-bonding and stainless steel honeycomb brazing techniques used in fabricating the supersonic craft. He told how the problems of severely contoured fuselages "vary by the square of the shape in B-58 tooling."

As an example of close-tolerance nightmares, he related how a fixturing problem demanded pinpointing a spot in space 32 feet up, not off more than six-thousandths of an inch. A gremlin that plagued this particular job for a while was the overnight movement of the fixture caused by the janitor's leaving a door open for two hours, with a 20-degree temperature drop and resultant metal contraction.

Fuhrer stressed the mounting responsibilities of tool engineers on the threshold of the space era. "Design people have been trying to design stuff we can't build," he said. "They haven't. But lately, they're really putting us to the test—designing things that they themselves can hardly put on paper."

The Fort Worth-Dallas delegation invited East Texas members to join in a two-chapter tour of Convair numerical controls departments.

SAN FRANCISCO—Pictured is one of the many round-table discussions which took place at the California Council of Chapters held at the St. Francis Hotel in San Francisco on Jan. 17. Meeting in northern California for the first time, the delegates heard ASTE National President George Goodwin speak on the importance of the individual ASTE member, cooperation with educators, promoting company training programs, and tool engineering as a career. *—Charles H. Driesbock*

New Haven To Study Numerical Controls

NEW HAVEN—Three aspects of numerical control will be on the discussion list during a three-program series to be presented by the education committee this month. The discussion groups have been designed to give members a basic understanding of numerical control, how it works, what it will do, and how to program operations. Organizing plant facilities for the effective use of this new tool will also be considered.

The first session, on March 2, will be entitled "Introduction to Numerical Control." "Organizing for Numerical Control" on March 9 will constitute the second meeting. George Dautrich, district application engineer for General Electric Co., and Vincent Loscalzo, sales engineer for the same firm, will be the discussion leaders at these two sessions.

On March 16 the series will be concluded by a visit to the Pratt & Whitney Co. in West Hartford where members will view "Numerical Control in Action."

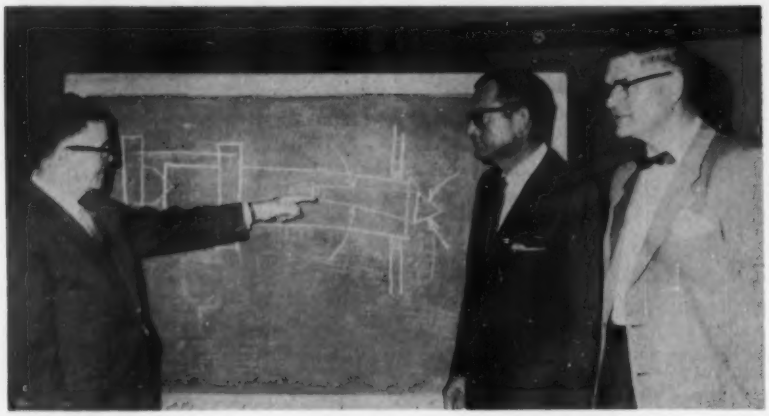
Vertical Take-Off Craft Described to Executives

NORTH TEXAS — Approximately 25 executives from the various industrial and tooling firms in the Fort Worth and Dallas area were guests at the Annual Executive Night held by North Texas chapter. This affair, designed to keep the industrialists aware of the vital importance of the tool engineer in producing quality products and services at competitive costs, was highlighted by a talk on the "Aerodyne" by Alexander M. Lippisch, director of Collins Aeronautical Laboratory, Collins Radio Co., Cedar Rapids, Iowa.

Dr. Lippisch, who is the father of the Delta-wing configuration for high-speed aircraft, illustrated his talk with motion pictures of the Aerodyne, a vertical take-off and landing craft with range and speed comparable to conventional aircraft. This craft employs an enshrouded propulsion unit and utilizes entrainment of external air mass to produce the lifting forces in conjunction with internal flow directed by deflecting vanes.

—William Engelfried

Hans Metz (left), past chairman of Chapter #28, and Bob Schlitzkus, Golden Gate member, observe the operator at one of the larger punch presses in the Marchant plant.



TUCSON—James Meehan (left), assistant to general sales manager, Machine Tool Div., Brown & Sharpe Mfg. Co., proves a point of his talk on "Grinding to Limits of Millionths, a Practical Reality" given at the January meeting. Listening are Chapter Chairman Harry DeLong (center) and Prof. A. G. Foster, University of Arizona, the most recent addition to chapter membership. *—J. W. Vincent*

280 View Results of Companies' Merger In Marchant Tour

GOLDEN GATE—The results of a merger between two of the largest manufacturers of business machines were taken in by 280 members of the Golden Gate chapter on their Jan. 21 plant tour. The scene of this tour was the Marchant division of Smith-Corona Marchant Inc., whose multimillion-dollar plant facilities are housed at Oakland, Calif.

Established in 1910 for the manufacturer of mechanical calculators, the Marchant firm grew steadily until it was recognized by management that further expansion was no longer economical without a new concept of plant layout. Work along this line was begun in 1955, ground broken in 1956 and the move to the new plant completed in 1958. Last year also saw the union of the two companies.

Marchant now has an almost completely self-sufficient production operation in one plant. Using one of the largest batteries of screw machines in the West, the plant turns out parts by the millions to be assembled, together with punch-press parts, into the company's products.

A "programmed monorail conveyor system" carries a continuous and automatic flow of parts between the various manufacturing areas. It unites the central parts storeroom on the second floor with these same manufacturing departments. Destination and quantity of loads being dispatched are entered into the programming device by the operator. This device uses a standard Marchant key section assembly. After unloading, the empty tote pans are programmed back to the originating department. This practically eliminates hand trucking in the plant.

Marchant's new tool and die storage vault facilities are located in a three-level steel structure situated between two floors of the factory building. This three-floors-in-two arrangement provides a 50 percent added capacity. The initial move into the new vault site involved 10,000 dies, milling, drilling and other fixtures with a replacement value of $5 million. The vault is served by a 4000-lb capacity freight elevator which fulfills the purpose of transporting dies from the punch presses on the first floor to the second-floor toolroom located adjacent to the tool vault.

Viewing the utmost in modern factory facilities and receiving exacting explanations of these modern miracles made the Marchant plant tour an enjoyable one for the Golden Gaters.

—G. Kenneth Dunn

chapter news

Santa Ana Valley Chapter Obtains TE Curriculum

SANTA ANA VALLEY—Another school to be added to the increasing list of those offering tool engineering courses is Santa Ana College. Plans for this undertaking were announced at Chapter #119's February technical meeting. As has been the case in other areas where tool engineering courses are introduced into a school, the local ASTE chapter was the driving force behind the move. The Santa Ana Valley chapter approved the program and requested its introduction to help relieve the shortage of trained personnel in various technical fields.

The program, which was especially designed for students who wish to seek employment in industry after two years of junior college training in engineering, was also encouraged by employers in the Orange County area. Since the curriculum is part of a four-year program, students who complete it may continue on to an engineering degree. Heading the new program will be Glenn Larsen, instructor of metal trades in the industrial education department of Santa Ana College.

A noncredit course concentrated in tool design and also under the sponsorship of the Santa Ana Valley chapter is being conducted on the same campus.

Along with election of new chapter officers, other highlights of the meeting were talks given by Leo M. Cross and James W. Green on numerical control, past and present. Cross is regional sales manager of True-Trace Sales Corp. The Automation Corporation of America retains Green's services as vice president.

—Robert C. Gordon

Discussing plans for the tool engineering course at Santa Ana College are (left to right) Dave Hartman, education chairman of Chapter #119 and instructor at the college; Leroy Connelly, past chairman; and Glenn Larsen, chapter member and also an instructor at the school.

Lima Industrialists, Educators Hear Long

LIMA—Dale Long, president of Scully, Jones & Co. and ASTE national vice president, was the guest of honor at the Lima chapter's first annual Executive and Educator Night. His talk on "Industry and ASTE Partnership" was especially fitting, as the main objective of the meeting was to acquaint local industrial and educational representatives with the Society's progress, its aims and of what importance it is to them.

Evidently Long's speech made an impression on more than a few of the dignitaries present, for one of them, Dean Archer of Ohio Northern University, was very much interested in what he should do to set up tool engineering courses at his institution.

—Andrew C. Farkas, Jr.

Production Institute Scheduled at Wichita

WICHITA — A high-level technical Production Institute centered around the theme "Grooming Production for This Space Age" will be held at the University of Wichita on May 4 and 5 under the auspices of the Wichita ASTE chapter and the university's student chapter. Prof. B. M. Aldrich, department of mechanical engineering, is the program coordinator.

Designed to instruct industrial executives and others in similar positions of management and production, the institute will deal with pertinent phases of production, including current practices and problems as well as those which face industry in the immediate future. A $40 fee for the Production Institute will include registration, banquet ticket and two luncheon tickets.

Congratulating Prof. J. H. Billings (left) for his stimulating talk on engineering education at the February meeting is Education Chairman H. DiPaul of Philadelphia chapter.

Engineering Education – Scientific or Practical?

PHILADELPHIA—Should educators concentrate on filling their students with the pure theory of engineering, or should they go to the other extreme and train them as technicians, that is, as specialists in a specific field? This "scientist versus practical engineer" question was raised by Prof. J. Harland Billings, chairman of the mechanical engineering department at Drexel Institute of Technology.

Speaking before numerous dignitaries from the education field at the Philadelphia chapter's Education Night, Professor Billings stated that the reason so little attention is paid to the practical end of the engineering business lies in the fact that there is insufficient time to do so. Thus, most educators believe it is their responsibility to provide the student with theory and leave it to industry to supply the practicalities.

The guest speaker also displayed an analog computer designed and built by Drexel Institute students. He suggested that this device be utilized by the tool engineer in his work, especially where automated machinery is concerned.

Relating the startling statistics dealing with the wide differences existing between engineering enrollment in Russia and the United States, Billings complimented the ASTE for its efforts to encourage young people to pursue technical education by means of scholarships.

The Education Night program with its visiting dignitaries was arranged by Education Chairman Hubert DiPaul.

—Jerry Weiland

Simplified Drafting Methods Are Outlined To 155 at Indianapolis

INDIANAPOLIS—One-hundred-fifty-five members and guests heard Jay H. Bergen, director of the engineering services laboratory, American Machine and Foundry Co., present his views on simplified drafting at the January chapter meeting. Bergen and his firm have spent considerable time and effort analyzing drafting room costs and methods. They found that the average man spends 73 percent of his time on productive work and the remainder on nonproductive. About a third of his productive work is in acquiring information. Much of this time could be eliminated by using clerical help to collect the information.

Bergen's staff found that on one job, completed by normal practice, 72 percent of the drawings contained more information than was necessary. Thirty-five percent of these might have been placed on smaller paper, nine percent of the total could have been typed, and 36 percent had unnecessary views, Bergen said. The final estimation showed that if these factors had been corrected the job would have been completed in 376 hours rather than the required 1150.

After such investigations Bergen's firm introduced a system of simplified drafting practices, resulting, they claim, in a 30 percent saving in drafting time. The system is based on reducing the time required in 11 general areas. The suggestions are: using description to eliminate delineation; using description to eliminate projected views; omitting elaborated pictorial or repetitive detail; using key legends to indicate hardware; using dotted lines only to aid clarification; eliminating most cross-hatchings; using symbols to indicate various hole sizes; avoiding the use of hand lettering; omitting arrowheads and replacing them with dots; using datum lines for dimensions; and finally, using freehand sketches for simple parts on sheets not larger than 17 x 22 inches.

—C. J. Myers

North Texas

New officers elected at the Feb. 12 meeting were: Ben C. Harris, chairman; Hal R. Montgomery, first vice chairman; Ernest D. Adams, second vice chairman; Reid R. Jamison, third vice chairman; Al Hall, secretary; and Paul R. Orbison, treasurer. The third vice chairman position is new this year. Also at the meeting, which took place at Western Hills Inn, members heard John W. Ripple and John A. Mueller of The Carborundum Co. speak on "Man-Made Diamonds."

Pictured during a cost-cutting symposium sponsored by Northrop Corp.'s Norair Div. are (left to right) ASTE Vice President Wayne Ewing, president of Arrowsmith Tool & Die Corp., Los Angeles; Jack Korbel, Norair; and P. A. Needham, vice president of H. W. Loud Machine Works, Inc. Executives of 165 key supplier firms in the Northrop supersonic trainer and fighter aircraft programs gathered at Hawthorne, Calif., to study ways of reducing the cost of military aircraft through management coordination and advanced techniques. They came from 20 states and Canada.

St. Louis Education Committee 'Sells' University on Tool Engineer Curriculum

ST. LOUIS—A meeting beginning on a nonreceptive note on the part of educational administrators toward the St. Louis chapter's education committee ended in what could only be called a cooperative, interested and friendly atmosphere. The two groups sitting down to discuss a proposed tool engineering program at Washington University resembled a delegation of labor leaders about to talk strike with representatives of management. By the end of the talks, however, the school heads had not only gained a new respect for the tool engineering profession, but they had also agreed to set up a five-year certificate program in production and tooling at the university's night school.

Literature published by National Headquarters played an important role in gaining the educators' confidence. It clarified for them the duties performed by the tool engineer in industry, and destroyed the false belief they nurtured that the tool engineer was nothing more than a tool and die designer.

Of course, this step toward raising tool engineering to its rightful status beside industrial, mechanical and other types of engineering was not accomplished at one sitting. The whole process of negotiation covered a span of five weeks. The men responsible for this program, which forecasts better things to come, were W. A. Scheublein, Chapter 17's second vice chairman; Herbert Klasek, Century Electric Co., St. Louis; and Herman Zimmerman, chairman of the education committee.

While the program was in the planning stage all subjects chosen for the curricula, with the exception of die design, were ones that had been taught within the university for many years. The problem was to select the proper ones from other courses of study and to group them under the new classification.

The certificate program was not the only idea considered. The ASTE representatives also received a guarantee that plans would soon be underway to set up a degree program in tool engineering at Washington's day school. A special department with its own head will be instituted to carry out the research and development necessary to raise the school's tooling and manufacturing subjects to the same academic level as other engineering courses.

Two problems resulting from the intended programs are the lack of a qualified department head and the scarcity of textbooks covering the specific subject of tool engineering. Both are being studied at the present time. The action being taken on these matters and the enthusiasm being shown toward the certificate program which is now underway are an indication of the feats the individual chapter can perform with the proper aid and the right spirit.

—Lyle R. Perry

Problems of Producing An Operational "Bird" Described on Coast

Speaking at two West Coast chapter meetings, one at San Francisco on Jan. 22 and the other on Feb. 18 at Golden Gate, was Dr. E. R. Mertz, associate director of personnel indoctrination and training, Aerojet-General Corp.

Contrasting the rocket engines of the past with their liquid fuel thrusts of a few thousand pounds, and those of the present and future running on solid fuel and possessing million-pound thrusts, Dr. Mertz spoke of the many problems encountered in producing the "hardware" for these rockets. One such problem was particularly emphasized—the production of gas generator injectors in which thousands of small holes are drilled. The contamination of a single one of these passages with chips or burrs could result in an unsuccessful firing. This problem has been remedied by means of the elox method, he said.

Mertz also related Aerojet's search for metals that could withstand temperatures ranging from minus 300 degrees to better than 5000 degrees F. At one time molybdenum was considered to be the answer but, since it is getting into temperatures beyond its limits, the engineers are looking into super alloys and even into the refractory metals such as tantalum and tungsten. New methods are also being employed by the company's tool engineers. A switch has been made from welding to furnace brazing, and from forgings to castings. Dr. Mertz pointed out that nothing less than precision watchmaker techniques is used in the fabrication and building of the 60-ton missiles.

The Golden Gate chapter elected a new slate of officers. And an additional highlight of the San Francisco meeting was the introduction of Gilbert Seeley, national education director.

—G. Kenneth Dunn and Chester L. Norton

Cincinnati

Harold Wagner, of the Engineering Department of Standard Electrical Tool Co., spoke to 55 persons at the Feb. 10 meeting. His subject was "Potential Unlimited" and with the aid of slides he covered the origin, comparison of types, and basic fundamentals for usage of electrolytic grinding and application. Subtopics of discussion covered comparison of methods, fundamentals of usage of Anocut type electrolytic grinding method, metal removal rates and feed rates, wheels and their function with the electrolytic grinding system.

SANTA MONICA—Tom Curtis, chief systems test engineer, Autonetics Div., North American Aviation Inc., speaking at the Jan. 15 meeting, tells of his responsibilities for the maintenance and operation of the inertial navigation system which guided the Nautilus on its historic transpolar journey.

—Charles V. Livezey

Electrical Controls Series Well Attended

DAYTON—A well attended series of seminar sessions on "Electrical Controls for Machine Tool Application" has just been concluded in the Dayton area. Sponsored by Chapter #18, the three-hour evening sessions were conducted by qualified experts in the electrical control and motor fields on Feb. 10, 17 and 24 and March 3.

The seminar was patterned on the outstandingly successful conference on hydraulics held last year.

The four meetings covered "The Fundamentals of Electricity," by R. Kyvik, of the Dayton Power & Light Co.; "Electrical Control Components," by Gene Ingle, Square D Co.; "Control Design and Components," by Wally Hammer, Allen Bradley Co.; and "Specifying and Selecting Electric Motors," by Ray Congleton, Master Electric Div., General Electric.

—Price H. Powell

Western Reserve

"Vibratory Feeding on Small Parts" was the subject of a talk presented by W. L. McKinsey, Jr., manager of the parts handling equipment department, Syntron Co., at the Jan. 23 technical meeting. McKinsey, with the aid of sketches, explained the principle of a syntron feeder and the formula for determining the feed rate of a given part.

Indianapolis Expands Program for Students, Sets Up Special Fund

INDIANAPOLIS — Chapter #37 has been quite concerned with the problem of cost of chapter activities as far as student members are concerned. It decided that too many students were staying away from dinner meetings and plant tours because of the fees.

The chapter's solution has been to set aside a special student fund, made up of that portion of affiliate membership fees returned to the chapter treasury and of donations from businesses and individuals.

In addition, the cost of tickets to regular dinner meetings has been reduced to one dollar for student members and the cost of out-of-town plant tours has been cut to one-half the regular fee for the students. The difference in this special ticket cost and the actual cost is being made up from the student fund.

The chapter education committee is also planning "in-plant instruction" for student members, whereby a group of students will be taken into local industrial plants and given demonstrations on the operation, use, and limitations of various machine tools. Costs of such activities will again be covered by the student fund.

Affiliate memberships are now being solicited to build up this new fund. To date, the chapter has Crucible Steel Co. as an affiliate member and has received donations to the student fund from Louis C. Buehler, Indiana Gear Works; D. D. Potter, Monarch Machine Tool Co.; and Past Chairman H. D. ("Pop") Hiatt.

The chapter leaders believe it is vital for students to attend their meetings and become acquainted with the men they plan to work with later on. Twenty-one students attended the February meeting under this plan.

These new officers were elected: Murray Davidson, chairman; Byron Confer, first vice chairman; Robert Mewhinney, second vice chairman; Alfred Mendez, secretary; and Richard C. Spoor, treasurer. Roy Erickson is outgoing chairman.

—C. J. Meyers

Ann Arbor

Carl Fosbender, chief mechanical engineer for Tecumseh Products Co., presented some vital statistics of his company's history to 75 chapter members who participated in the plant tour on Feb. 18. Visitors saw the processes of manufacture from initial machining of rough castings to dip test following final assembly.

'Late Late Show' Added at Houston

Some members just don't want to go home after meetings. They hang around talking shop, getting in the way of people trying to clean up their dirty dishes and cigarette butts, shaking hands and pounding the ears of the tired speaker of the evening, cluttering up the hotel lobby—sometimes going on midnight "plant tours."

As a gesture toward such enthusiastic members, and toward their wives who might be worrying about their whereabouts, Houston chapter has come up with an extra added attraction that seems to be keeping them interested and out of trouble at the same time. It's a "Late Late Show," and recent attractions have been attended by well over half the regular meeting crowd on hand.

The shows are educational and informative and all that. One of the recent ones, for instance, was "Uses Unlimited," a Minneapolis-Honeywell film on the design, production, testing and usages of Micro-Switches in controls.

Of course, some of the incurably enthusiastic members still hang around even after the late show, talking shop and cluttering up the hotel lobby. . . .

—John Beman

Thomas Alexander (right), assistant plant manager, welcomes ASTE President George Goodwin to the Bristol plant of Raytheon, Inc. Goodwin toured the facility prior to his officiating at the chartering of Chapter #155. Alexander spoke at the ceremonies.

Bristol Chapter Launched With 100 Members

BRISTOL, TENN.-VA.—Senior Chapter #155, comprised of 100 charter members, was launched at ceremonies Feb. 19. President George E. Goodwin officiated.

Accepting the charter for the Society's newest chapter was Ralph W. Burton, chairman. Other officers include C. T. Collins, first vice chairman; M. E. Passmore, second vice chairman; J. R. Sullivan, secretary; and Frank Hughes, treasurer.

William T. Martin, president of Sullins College, was principal speaker of the evening. His topic was "Current Trends in Education."

The new ASTE unit, described as Bristol's first technical society, was an outgrowth of Piedmont chapter. The two largest industries in the Bristol area are Raytheon and the Sperry Farragut Co.

—Edward F. Moore

Talking over old times at the February meeting of Houston chapter are two of its old-timers, L. M. ("Red") Cole, one of the organizers and second chairman of the chapter, and H. E. ("Rip") Collins, immediate past president of the ASTE. Photo is by L. V. Dolan, also one of the handful who helped organize the chapter 20 years ago.

Collins Awarded Life Membership Plaque at Houston

HOUSTON—In the highlight of a meeting chock-full of members and memories, Chairman S. E. Rees presented a Life Membership certificate to the chapter's most illustrious native son, Past National President Harold E. ("Rip") Collins.

Collins, who is foreign operations manager of the Hughes Tool Co., accepted the national tribute humbly and declared that much of his ASTE accomplishment should be credited to the enthusiasm and backing of past and present fellow chapter members.

One of the most distinguished past chapter members, L. M. Cole, was present. "Red" Cole, now a Southern Northerner who is general sales manager of the Warner & Swasey Co. and a member of Cleveland chapter, reminisced on the founding of Houston chapter 20 years ago—on his front porch.

From the half-dozen present at that first gathering in the spring of 1939, the chapter has grown to 637 members.

The 160 at the Feb. 10 meeting elected these officers: C. R. Hay, process analyst of Hughes Tool, chairman; Harry Betts, tool sales, first vice chairman; A. G. Meyer, chief tool engineer at Continental Emsco Co., second vice chairman; A. F. Huge, president of August F. Huge & Son, Inc., secretary; and R. M. Hoffman, tool control supervisor, Reed Roller Bit Co., treasurer.

They also heard a talk on "Standard Tools vs. Special Tools" by Carl J. Oxford, Jr., research director for National Twist Drill & Tool Co. Oxford said, in essence, that a tool engineer should thoroughly examine the 15 to 20 thousand stock offerings in standard tool catalogs before deciding he must design a special tool. *—L. F. Skelley*

SPECIAL EVENTS

ASTE 27th Annual Meeting	April 18-22	Schroeder Hotel, Milwaukee, Wis.
State University of Iowa—On-Campus Conference	April 18	Iowa City, Iowa
Purdue University—On-Campus Conference	April 26	Lafayette, Ind.
"Analysis of Metal-Cutting Methods"—ASTE Seminar	April 9-10	Benjamin Franklin Hotel, Philadelphia
"Tooling for Metal Powder Parts"—ASTE Seminar	April 24	Sheraton-Palace Hotel, San Francisco

SAGINAW VALLEY—Guest Speaker Frank Suchanek, sales engineer for Sundstrand Magnetic Products Co., Rockford, Ill., demonstrates a point of his talk on electromagnetic chucking devices to Program Chairman Michael Hresko and Chapter Chairman Peter Duch. *—Robert Elliott*

Kalamazoo

"Designing with Plastics" was the subject presented at the Jan. 22 meeting by three experts in their fields. Miller Sherwood, president of Michigan Plastic Products, discussed extruded and molded parts; Robert Poehlman, Trio Mfg. Co., covered hand lay-up fiber glass parts; and Robert Kittredge, president of Fabri-Kal Corp., presented packaging and parts made from sheet plastics.

San Antonio

About 25 members—including one with his three sons and grandson along—attended the election night dinner meeting. These 1959-60 officers were elected by acclamation: Willard A. Lang, chairman; James B. Frix, first vice chairman; Richard A. Pierce, second vice chairman; Joe Gueldner, secretary; and E. Whitney, treasurer. A 40-minute movie was shown on automation developments at the Volkswagenwerk in West Germany.

Obituaries

George E. Bader, Chicago, vice president of Precision Scientific Co.

Edward M. Bosanac, Chicago, planning engineer for Hot Point Co.

Ralph H. Cox, Buffalo-Niagara, sales engineer for National Automatic Tool Co.

Joseph A. Devine, Lexington, supervisor and process engineer for Raytheon Mfg. Co.

George Forbes, Toronto, manager of Surveying & Drawing Supply Co.

Percy O. Gibson, Kokomo, president of Kokomo Machine Co.

John J. Haley, Merrimack Valley, toolroom section chief for Western Electric Co., Inc.

Gordon A. Kartzmark, Toronto, technical sales representative for Canada Iron Foundries, Ltd.

Theodore R. Timm, Saginaw, general master mechanic for Buick Motor Div., GMC.

Richard A. Wuerch, Madison, industrial representative for Socony Mobil Oil Co.

Dayton

Eighty-five persons heard Joseph A. Tsenka, field engineer for National Broach & Machine Co., discuss "Broaching and Broaching Practices" at the Feb. 16 meeting. Tsenka illustrated his points with slides, the while discussing actual practice on internal broaching in gears and other parts.

Members and guests took part in a plant tour of McCall Corp., one of the world's largest contract printing plants, where approximately 2,000,000 magazines are printed, bound and shipped every working day. The wide variety of automated transfer devices was of particular interest to the tool engineers on this two-hour trip.

Positions Wanted

TOOL DESIGNER—Recent tool and die designing graduate wishes interview with manufacturer in or around Cleveland, Ohio. I am heavy in the education factor, though weak in the experience factor. I wish a chance to get started in the design field. Write to: Box 142, News Dept., The Tool Engineer, 10700 Puritan Ave., Detroit 38, Mich.

MANUFACTURING EXECUTIVE—Heavy experience in sheet metal and manufacturing machining. Strong background in estimating, scheduling, installing new systems and production methods, sourcing and purchasing. Ten years' supervisory background in charge of plant maintenance, safety, machine shop, production assembly operations. Experience in employee relations. Will relocate. Write to: Box 140, News Dept., The Tool Engineer, 10700 Puritan Ave., Detroit 38, Mich.

Positions Available

CHIEF INDUSTRIAL ENGINEER—Supervise and coordinate the following functions: process drawings, manufacturing process planning, work standards, methods, tool and die design and procurement, machine repair tool cribs, tool grinding and tool salvage. Write to: Mr. D. A. Kubelsky, manager of engineering, National Forge Co., Irvine, Warren County, Pa.

TOOL ENGINEER—with approximately 10 years' design experience on blanking, punching and forming dies. Must have practical background and good knowledge of modern fabrication methods. Attractive offer for qualified men in progressive sheet metal fabricating plant located in Eastern Pennsylvania. Correspondence confidential. Write to: Box No. 141, News Dept., The Tool Engineer, 10700 Puritan Ave., Detroit 38, Mich.

SENIOR DIE DESIGNER—Design dies and coordinate the design activities as related to product processing, sales inquiries, die cost estimating, and customer contacts. Write to: Mr. D. A. Kubelsky, manager of engineering, National Forge Co., Irvine, Warren County, Pa.

SALES REPRESENTATIVE WANTED—Well-established and growing company making custom tools from epoxy resins, fiberglass and related materials needs representation in the following states: Western New York, Maine, New Hampshire, Vermont, Connecticut, Massachusetts, Rhode Island, North Carolina, and Ohio. Liberal commission and exclusive territory given to right men. Write: Latrobe Plastic Co., 310 Unity St., Latrobe, Pa.

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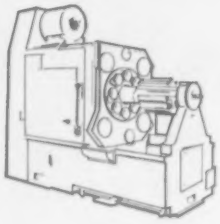

This means that the operations to be completed at each individual station can have feeds and speeds set up for maximum production efficiency, as well as for the optimum feed and speed conditions required for precision tolerances and surface finish.

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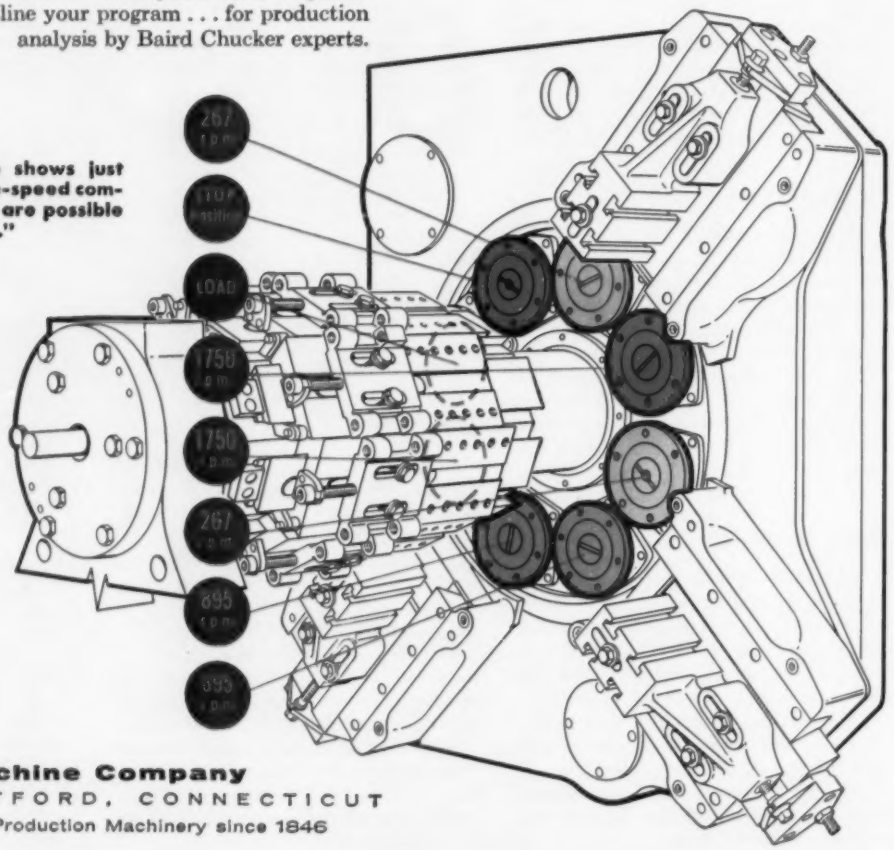

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Progress in Production

CASTING TECHNIQUE SHOWS PRODUCTION PROMISE

Producers of extrusion billets, wire bars and rolling mill slabs may get an advantage from a continuous casting technique described by Lobeck Casting Processes Inc. Designed for application to heavy nonferrous metals and alloys, it employs semicontinuous, hydraulically operated equipment.

With this technique, liquid metal flows from the induction furnace spout

along a launder to a distributor which provides a smooth, splash-free entry of metal into the molds. Passing through the water-jacketed "bottomless" molds, the metal cools rapidly and is solid by the time it leaves the molds. The molds are continuously filled with molten metal to match the withdrawal of solidified castings until the ingots have been cast to required length.

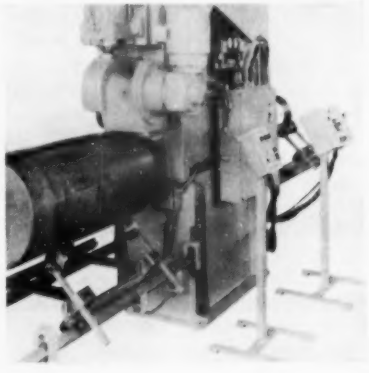
Currently the casting machines are used to produce multiple-strand extrusion billets up to 10 in. diameter and rolling mill slabs up to 6 by 24 in., in lengths up to 20 ft. Each station has a separate hydraulic power unit which allows speed of casting and length of stroke of the hydraulic ram to be carefully controlled. A single operator with a helper assisting as start of casting and at final removal of the billets or slabs by overhead crane can control the machine.

With this equipment, plant productivity has shown an improvement because of mechanized operation and larger ingot sizes. Steady casting conditions result in uniform, dense ingot structure from end to end, while smooth metal pouring prevents turbulence and entrapped gases and impurities. Rapid cooling produces a fine grained structure regardless of large cross sections; and predominantly longitudinal solidification seems to prevent piping and internal stresses.

DUAL PURPOSE EQUIPMENT ROLLS BUTT AND SEAM WELDS

Smooth, fast rolling of both butt and lap seam welds is the job of a combination dual purpose longitudinal-circumferential weld roller developed by Grotnes Machine Works. The hydraulically operated equipment, now in operation at a jet engine plant, develops 25 tons at top pressure of 1,000 psi at the rolls. With this force, rolled welds are flattened to the thickness of the parent metal and parts can be processed without further work on the welds.

Longitudinal weld is being rolled on the 2 IC combination longitudinal circumferencial Grotnes weld roller. The circumferential rolling mechanism can be seen on the far side of the machine.



Prime feature of the machine is that a force of 25 tons is available on either end. The longitudinal end rolls welds on parts with diameters ranging from 5¼ in. minimum to 36 in. maximum with one pass rolling on work up to 14½ in. long with a minimum diameter of 5¼, and up to 18½ in. long on pieces with diameters greater than 8 in. ID. The circumferential roller end of the equipment will process parts with diameters from 5¼ to 36 in., with a distance of 2 to 18½ in. from edge of the part to the circumferential weld.

Rolling speed at either end is 60 fpm to provide a high production rate when necessary while upper and lower rolls can be profiled to conform to the shape of the part at the weld. Alloy steel horns in two diameters permit rolling of small diameter parts. An automatic timer is preset for number of revolutions required for the weld rolling.

ABRASIVE MAKER USES PULVERIZED DIAMOND

A possible advance in the manufacture of diamond abrasives has appeared with a process developed and put into operation by Diamond Tool Research Co., Inc. Under this technique, extreme pressures are used to break the diamond fragments into sound block grits. Silvers, flats and pieces with severe internal stresses are subjected to a pressure that breaks them repeatedly until only sturdy diamond grains result.

There are no rounded cutting edges on the abrasive grains. According to the company's engineers, the rounded grains cause frictional heat from rubbing, while the block shapes cut cooler, smoother and last longer while providing a fast cut. This cutting action in diamond wheels of the new "Pressure Tested" grits is attributed to the consistent shape and quality of the grits. So far the grit has been used in resinoid and metal bonded diamond wheels, saw blades, mining bits, as loose abrasives in graded sizes, and in diamond compound.

NYLON GUIDES ON GRINDER STOPS CHATTER PROBLEM

The buckling tendency of light-gage metal in pinch-roll grinding and polishing equipment, has been halted with an easily applied set of tapered nylon guides. Such vibrating trouble frequently occurs as the work both approaches

and leaves the abrasive belt, and often chatter marks are left on the work necessitating further operation.

At Behr-Manning Co. product engineers modified the feed system on standard pinch-roll machines by adding a simple framing of angle iron to hold tapered guides of molded nylon ⅛ in. thick and about 10 in. long. The nylon is clamped in place between cold-rolled strips, thus can be installed and replaced quickly.

The nylon strips are mounted both above and below the work, and troublesome flapping is ended. The clamping method permits the guides to be spaced accurately to accept sheets of different thicknesses.

'RESURFACING' FOR CARBIDE FACILITATES BRAZING

A treatment for carbide blanks is providing a surface that is reported to improve bonding and facilitates faster brazing. The technique, developed by the research department of National Twist Drill does not require the cleaning needed by previously used conventional processes. Where induction brazing is used, wiping during brazing is not necessary.

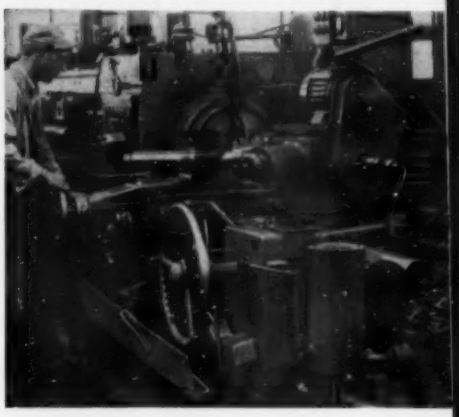
In the new Brazeez process, a film of cobalt approximately 100 microinches in depth resurfaces the carbide blank. This is achieved through a method of leaching the cobalt, which is used as the bonding agent, to the surface of the blank. This surface thus becomes wettable, increasing the carbide blank's affinity for brazing without wiping. When using the Brazeez process it is unnecessary to clean the carbide blanks by blasting with sand or aluminum oxide.

Tests and actual fabricating of carbide tipped tools within the National plant, where a wide range of carbide grades was used, have been unusually successful.

UNUSUAL LATHE SETUP RAISES SPEED AND QUALITY

Innovations in the Warner and Swasey semiautomatic turret lathe are bringing about faster production and better quality at The Timken Roller Bearing Co. where it is used to machine large tapered rollers.

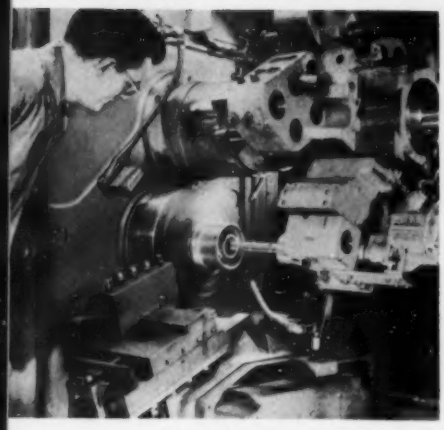
A contour attachment and a gun drill are integral parts of the machine. A Sesco bar feeding attachment built



specially for this turret lathe automatically replenishes stock. For the job that previously required two separate operations, the gun drill now completes the center hole of the rollers in a single operation. By means of a template, the contour attachment traces the shape of the roller being machined. With the feeding attachment, which holds six bars, there is no manual loading.

MACHINING TECHNIQUE SIMPLIFIES COMPLICATED JOB

An ingenious tooling arrangement is allowing Nordberg Mfg. Co. to machine two 1/16-in. wide snap ring grooves in the bore of ductile iron car wheels. Main handicap to successful use of conventional grooving cutters was the long overhang and the relatively small bore diameter. However, a pair of arbor-mounted slitting saws, driven by an air motor, and installed in a turret slide head mounted on the pentagon turret of a Warner & Swasey 3AC single-spindle chucking automatic, solved the problem.



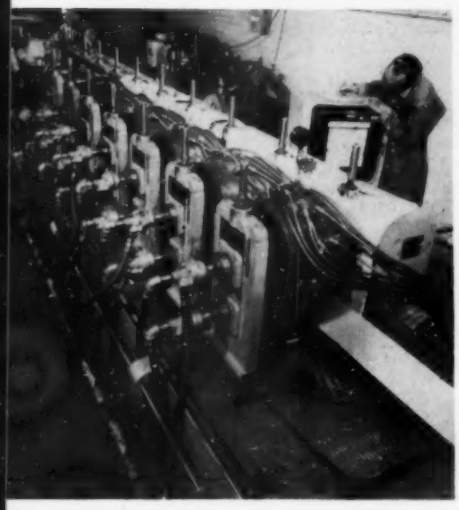
In operation, the pentagon turret comes forward in rapid traverse, accurately positioning the slitting saws longitudinally in the bore diameter of the car wheel. The rear cross slide then moves in, pushing the turret slide head at right angle to the machine center line. This feeds the saws to proper depth. A solenoid valve automatically starts the air motor when the saws are in working position; shuts the motor off when the turret indexes to the next station.

With the new setup, wheels are machined complete in one chucking, including backfacing, in 9½ minutes. Former time on turret lathes, involving two chuckings, was 72 minutes per piece.

ENCLOSED HEATING METHOD ADVANCES TITANIUM WORK

Successful forming of titanium high strength alloy is being accomplished on modified Yoder equipment at Boeing. In many cases, titanium can be formed only in the 1,000-1,600 F temperature range. Therefore, a factory technique for enclosing heating, developed at Boeing, is used to reach the required forming temperature. Furnaces enclose each individual set of rolls. Each encircling furnace has 18 burners around its periphery. In operation, the rolls glow a dull red. However, because of the installation of hollow shafts to carry circulating cooling water, bearings run cool despite the roll temperature. About an hour is needed for the rolls to reach correct forming temperature.

Tests have been conducted at a rolling speed of approximately 1½ fpm, but engineers suggest that speeds 12 to 15 times as fast are feasible. Most of the tests have been run using titanium alloy strips about 8 feet long, although a 32-foot strip has been rolled satisfactorily.

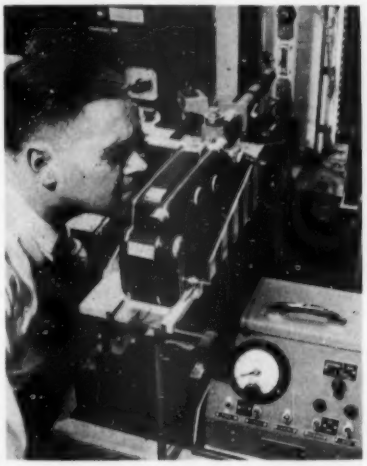


MOVIE MONITOR KEEPS CREEP STRAIN RECORD

Progress of microscope creep strain tests at elevated temperatures are being recorded by means of an unusual 16 mm camera setup at The Martin Co.'s Baltimore materials engineering laboratory. Results are extremely accurate records of creep strain.

Furnace (at upper right in illustration) is swung aside to disclose a test specimen to which a small, scribed slide rule type platinum gage has been clamped. Specimen and gage are magnified by a microscope. The image passes to both camera and optical viewer via a reflex. Time, stress and temperature information are fed into the film record by an imposition device. A solenoid-timer (at lower right in illustration) can be set for readings at any interval between 64 frames per second and one frame every ten hours.

A battery of cameras, linked to a single timer, is used to make synchronized records of several types of data.



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MICROtrol 170 transistorized gaging system, which includes a battery-powered amplifier and four types of interchangeable gage heads, is for use with production comparators, height gages, snap gages, ID or OD gages and similar bench inspection devices.

INDICATOR GAGE HEAD used with standard height gage-stand for surface plate work.

AGD GAGE HEAD used with snap gage for production line inspection.

FRICTIONLESS GAGE HEAD used with comparator stand to check production parts.

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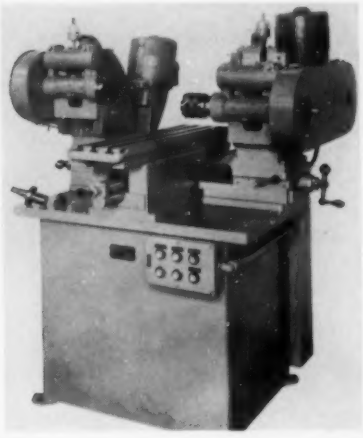
TOOLS of today

Duplex Half-Mill

Gang milling of flats on the opposed ends of short steel shafts can be accomplished efficiently on a high-production Duplex Half-Mill which can simultaneously mill 10 to 12 shafts. Although the cut is light, large cutters are used, necessitating slow spindle speeds. In place of a conventional gear motor, a flange-mounted 1800-rpm motor attached to a work and work wheel (10:1 reduction) speed reducer is used.

It provides unusually smooth operation and compact mounting. Spindle



speed range includes 86, 112, 143, 218, 278 and 360 rpm. In order to keep the opposed milling cutters from machining the same shaft at the same time, the Half-Mills are mounted with one leading the other by 1 in.

The machine shown has an 8 x 32-in. table. The table feed cycle is rapid approach, controlled cutting speed and distance, and automatic rapid return. The Duplex Half-Mill is also available with 6 x 23, 10 x 36, 10 x 42, 10 x 48 and 10 x 54 tables, as well as 12, 18, 24 and 30-in. air-hydraulic or 18 and 30-in. full hydraulic longitudinal table feed. Numerous other combinations of "building block" features are available for use with the single or double column Half-Mills.

U. S. Burke Machine Tool Div., Brotherton Rd. & Pennsylvania R. R., Cincinnati 27, Ohio. **T-4-1**

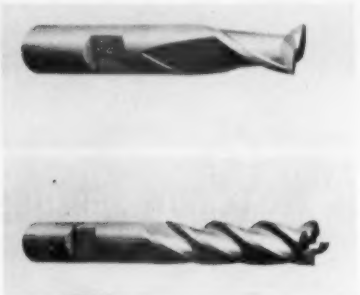
End Mills

G type end milling cutters are made with a generated flute shape in one continuous curved surface from the cutting face of one tooth to the cutting face of the adjacent tooth, including the relief back of the adjacent tooth. The tools are ground from solid.

Because of eccentric radial relief on the outside diameter, there is no danger of heel drag. The curved flute shape and highly polished flutes prevent chip traps.

Superficial surface treatments can also be added to the tools for best performance in varoius materials.

Four-tooth end mills from $\frac{1}{8}$ to $\frac{1}{2}$ in. in both single-end and double-end types



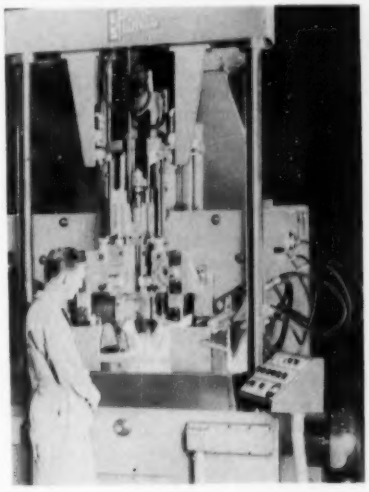
are available from stock, as are two-tooth mills in the single-end type from $\frac{1}{4}$ to $\frac{3}{8}$ in., and double end from $\frac{1}{8}$ to $\frac{3}{8}$ in.

Pratt & Whitney, Inc., West Hartford 1, Conn. **T-4-2**

Rotary Extrusion Machine

No. 12 vertical Floturn is specifically designed for high production "chipless" metal forming of parts ranging up to 16 in. in diameter and to 15 in. in length. Automatic cycling may include automatic loading and unloading. The vertical design incorporates radially-opposed Dual-Sincro rollers which minimize deflection and assure accuracy. Automatic hydraulic tracer control makes production of complex shapes a pushbutton operation.

The machine produces conical, cylin-



drical, contoured shapes or combinations of these shapes from flat blanks, preformed blanks or machined blanks of almost any metal or alloy.

The metal flowing rollers are synchronized; they work in the same plane, opposed to each other to eliminate deflection. The machine works on the sine law—the sine is the instantaneous angle between the centerline of the spindle and the tangent to the contour at the

point of roller contact.

Operation of the No. 12 vertical Floturn does not require a skilled operator. Set-up has been simplified in this model, and a representative job may be set up in as little as 45 minutes.

The machine incorporates automatic compensation for blank thickness variations. An inter-relation between the machine's ram (which holds the workpieces) and the template supports, automatically adjusts template position to compensate for the smallest practical variation in blank thickness.

The machine also is useful for research and development work, and can be used in experimental production of prototype parts and scaled-down models of larger parts.

It consists of a base containing spindle and spindle drive with the spindle arranged to take tooling for particular jobs plus clutch and brake, lubrication reservoirs and pumps, coolant tank and pump, etc. The column, rising from the base, has ways for the carriage and ram and also contains the carriage counterbalance. The ram carries a built-in live center to receive the spindles suitable for various workpieces. The carriage has two synchronized and hydraulically-actuated rollers. Action of the rollers in forming the part is tracer-controlled by individual templates. A wide range of adjustments are provided. All electrical control equipment for the machine is furnished in a floor-mounted cabinet which may be remotely located.

The Lodge & Shipley Co., 3077 Colerain Ave., Cincinnati 25, Ohio. **T-4-3**

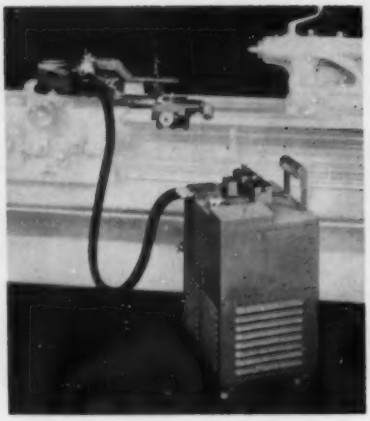
USE READER SERVICE CARD ON PAGE 175 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Air Tracer

A self-contained air gage tracer unit, for application to Monarch lathes, consists of a hydraulically powered tool slide and a swivel base. The assembly, called an Air-Tracer Pak, may be used on Series 60, 61 and 62 machines without any reduction of swing capacity.

The template support is clamped to the front bed Vee. Micrometer dials are provided for longitudinal and cross adjustment of the template position. For quick and accurate template alignment a swivel pin on the support is used in conjunction with a micrometer adjusting bracket. Mounting holes allow the bracket to be positioned properly for both short and long turning templates and for facing templates.

A portable self-contained power unit stands at the front of the machine. The hydraulic pump motor plugs in to a receptacle on the power unit base, where there also is a connection for the air supply line.



When not in use, the tracer slide assembly and template support are in storage brackets on top of the unit.

The hydraulic cylinder stroke is 3¾ in., permitting a 5 in. diameter change with the tracer slide set at 45 deg. Maximum template length is 18 in.

The Monarch Machine Tool Co., Sidney, Ohio. **T-4-4**

Insert Cutter Blocks

Throwaway insert blocks using square carbide tips provide elimination of carbide grinding, instant tip indexing, lower cost per cutting edge, while minimizing tool inventory. Designed for use in standard Davis block type boring bars, the blocks are available in two-cutter styles for rough boring, as well as single-cutter micrometer adjustable styles for semifinish or finish boring. Both styles are available with positive or negative rake, in Series G8, G6 and

G4, covering a bore range of 2½ through 17 in.

A screw type clamp holds the insert and carbide chip breaker in place. When the clamp is loosened, it travels forward over the chip breaker, partially ejecting the insert to enable easy indexing or replacement.

Two cutter blocks, with their opposed cutter design, prevent out-of-round boring. Diameter tolerances can be held to 0.004 in. Micrometer adjustable single cutter blocks employ a micrometer adjusting screw which positions the block in the bar slot permitting boring to tolerances of 0.001 in.

The blocks slip into the bar without disassembling, and are secured in the bar slot by a single tapered locating screw.

Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. **T-4-5**

Screwdriver-Nut Runner

Because of automatic triggering incorporated in the mechanism of the Clecomatic screwdriver-nut runner, starting and stopping are automatic. The operator engages the screw with the

finder and bit; when the screw or nut has been tightened to torque specifications, the mechanism shuts the air motor off automatically. The air motor runs only during actual rundown.

A second feature of the tool is the nonfriction torque-limiting clutch. This has a no-drift adjustment which permits torque to be precisely preset and maintained.

Capacity of the tool is ¼ in. free running and No. 10 self tapping.

The screwdriver-nut runner also is available in a right-angle model.

Cleco Air Tools, Houston, Texas. **T-4-6**

Toolmakers Vise

Because it is precisely square on all six sides, the Frederiksen toolmakers vise facilitates grinding or milling work absolutely square easily and quickly. The vise is designed with a 2-in. capacity with a disappearing screw.

F. T. Frederiksen Tool & Die Co., 54 Clinton St., Yonkers, N. Y. **T-4-7**

Drilling and Tapping Units

Quills are fully extended on these automatic attachments to show available strokes—4 in. on the 4 and 5 units, 5 in. on the 16 and 17 units. Models 4 and 16 are drilling units, 5 and 17 their companion tapping units.

A cam feed assures accurate repetition of the work cycle. Follower segments make the stroke of the spindle double that of the feed cam. Changing speed and feed gears and the feed cam, provides different speeds, feeds and strokes.

Model 4 drilling unit affords 750 to 4100 spindle rpm or 1500 to 8200 spindle rpm in the ½ and 1 hp sizes with ⅜ in. capacity in cast iron and 5/16 in. in forged steel.

The ¾ hp Model 5 tapper offers a spindle speed of 465 to 1415 rpm, and will tap ⅜ - 16 in cast iron or 5/16 - 18 forged steel. Model 17 tapper, with 1 hp, has spindle speed of 368 to 2160 and handles ⅝ - 11 in cast iron or ½ - 20 in forged steel.

Each drilling unit may be converted to its companion tapping unit by using a different feed cam, a reversing motor,

and controls to reverse them. The tapping units can have time cycles as short as 3 seconds.

Each unit has a positive drive with friction safety clutch. A rotary pump supplies a continuous flow of oil. Controls may be either air or electric and are interchangeable. Units may be mounted at any angle.

Kingsbury Machine Tool Co., Keene, N. H. **T-4-8**

Small Hole Driller

Fast small hole drilling is simplified by this drill unit designed for use on milling machines, jig borers, lathes and drill presses. The tool is locked into position; drilling pressure is controlled

by the finger tips. Drill breakage is minimized. The operator "feels" correct cutting pressure.

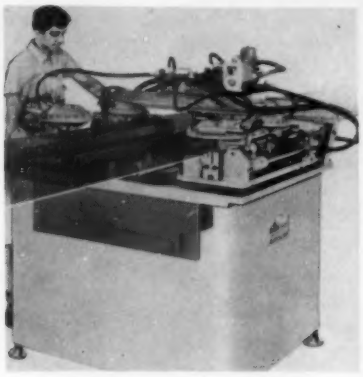
Hunter Tool, P. O. Box 564, Whittier, Calif. **T-4-9**

Double Air Feed

Built in sizes to handle materials up to 36, 48 and 60 in. wide, the Ses-Matic double air feeds can be used for feeding stock to almost any press or shear. They can feed from the front, back, or either side, or are easily moved from one press or shear to another. The only tie-in necessary to a press or shear is the mounting of a limit switch in such a manner that it is tripped on the upstroke of the machine. This energizes a solenoid operated valve which in turn cycles the feed. The air feed is an-

chored to the press or shear by a tie-in bar across the front of its fabricated base.

In operation, the stock is gripped along both edges of its width and carried forward by two gripper heads. Stroke length is infinitely adjustable to the maximum of the unit. Metal-to-metal stops insure exact duplication of stroke length. The stroke is cushioned at each end by a self-contained hydraulic check. No adjustment is necessary for changing from one stock thickness to another.



Special Engineering Service, Inc., 8161 Livernois Ave., Detroit 4, Mich.

T-4-10

USE READER SERVICE CARD ON PAGE 175 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Portable Hydraulic Punch

This portable hydraulic punch, called the Hydramic, facilitates hole forming in large or hard-to-handle pieces. Available in a range of capacities from 5 to 90 tons, the largest will punch up to $1\frac{1}{16}$-in. hole through $\frac{7}{8}$, or 1-in. hole through 1 in. of mild steel.

The complete tool consists of a punch unit with pushbutton control box, a hydraulic power unit, and interconnecting flexible hydraulic lines. Punch units, with from 5 through 30-ton capacity, are light enough to be carried from job to job; heavier units of 50, 70 and 90-ton capacities have the power unit mounted on a cart, while the punch unit is suspended from a castered tripod, crane, hoist, etc.

A single operator can locate and control the unit. Controls on the cylinder of the punching unit manage descent and retraction of the punch, and the operator has full control over start, stop and reverse ram movement which permits jogging. Cycle time of these units ranges from 2 to 19 seconds, depending on size, and they can be in-

(Continued on page 177)

MULTIPLE FEED-OUTS...

A Natural

on Greenlee Air-Feed Automatics

Feed Out Stock to 16½"
Eliminate Pushers and Feed-Out Cams

Removable fittings attach air lines to the stock reel tubes. A vacuum pump withdraws the piston when restocking. Push-button control panel is provided for starting and stopping.

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2. Stock can be automatically air-fed to position in one or more machining stations permitting two or more pieces per cycle.
3. Multiple feed-out flexibility enables you to finish machine a variety of pieces that ordinarily demand costly second operation setups.

If you are running into production headaches on a specific job, Greenlee may be able to adapt an "Air-Feed" to solve your problem. See your Greenlee Distributor.

Write for your copy of Catalog A-405 — first step on the way to more profitable production with Greenlee Automatic Bar Machines.

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A-4-212—Drills—*Ace Drill Corp.* Catalog describing entire line of Ace high-speed steel and carbide drills, reamers, drill blanks and special drills. (Page 212)

A-4-261—Drill Bushings—*Acme Industrial Co.* Drill bushing selector for all standard sizes now available. (Page 261)

A-4-180-1—Micrometer—*Alina Corp.* Catalog gives information on a one piece stainless steel spindle Etalon micrometer and other precision measuring instruments. (Page 180)

A-4-269—Carbide Tools—*Carmet Div. Allegheny Ludlum Steel Corp.* 32-page Carmet catalog contains prices and specifications of carbide insert tools and holders. (Page 269)

A-4-14—Lathes—*American Tool Works Co.* Features of the American deluxe model "Pacemakers" are described in illustrated bulletin No. 150. (Page 14)

A-4-186—Metalcutting Saws—*Armstrong-Blum Mfg. Co.* Catalog C85 has complete details, facts and figures on Marvel metalcutting hack saws and band saws. (Page 186)

A-4-208—Clamps—*Armstrong Bros. Tool Co.* New general catalog has details on almost 5000 industrial tools. (Page 208)

A-4-202—Bulge-forming Machine—*Arrowsmith Tool & Die Corp.* Technical information available on the Arrowsmith Hydro-sizer machines for forming and sizing. (Page 202)

A-4-183—Carbide Tools—*Atrax Co.* Data on solid carbide tools and burs described in 148-page catalog. (Page 183)

A-4-206—Vibratory Feeders—*Automation Devices, Inc.* Informative bulletin "packaged automation" available on request. (Page 206)

A-4-224-3—Indicating Gage—*Bedford Gear and Machine Products, Inc.* Specifications and data on Bedford universal indicating gage available in free catalog No. 10. (Page 224)

A-4-247—Drill Unit—*The Bellows Co.* Features of the "Carbi-Drill" unit are described in bulletin CD-17. (Page 247)

A-4-180-2—Rotary Table—*Bentley Industrial Corp.* Illustrated brochure available describing OMT 12 and 16 inch optical rotary and inclinable table. (Page 180)

A-4-260—Taps—*Besly-Welles Corp.* New booklet "How to Form Internal Threads Without Cutting" contains complete data on X-press taps. (Page 260)

A-4-30—Surface Grinding—*Blanchard Machine Co.* Copy of the booklet "The Art of Blanchard Surface Grinding" now available. (Page 30)

A-4-199—Boring Head—*Briney Mfg. Co.* Catalog describes the features of the Briney size positive boring heads and discusses savings possible with it. (Page 199)

A-4-218—Milling Cutters—*Brown & Sharpe Cutting Tool Div.* Cutter data available in new B & S high-speed steel and Nelco carbide tool catalogs. (Page 218)

A-4-258-1—Machine Covers—*Central Safety Equipment Co.* New data sheet '58 and complete information available on elasticone covers. (Page 258)

A-4-240—Lapping Machine—*Crane Packing Co.* Bulletins describe the complete Lapmaster line and contain charts for measuring flatness. (Page 240)

A-4-23—Chucks—*The Cushman Chuck Co.* Bulletin PO-65D describes applications of the Cushman air operated chucking equipment. (Page 23)

A-4-258-4—Die Cushions—*Dayton Rogers Mfg. Co.* Catalog F-44-A contains complete information on the full universal pneumatic die cushions. (Page 258)

A-4-254—Hydraulic Press—*Denison Engineering Div. of American Brake Shoe Co.* Detailed bulletin available on the Denison model "A" multipress. (Page 254)

A-4-274-1—Machine Tools—*F. W. Derbyshire, Inc.* Catalog describes complete line of Derbyshire small precision turning and milling machines. (Page 274)

A-4-246—Clamps—*Detroit Stamping Co.* Catalog shows clamp applications, scale drawings and complete information on DEStaCo clamps. (Page 246)

A-4-167—Tooling Plastic—*Devcon Corp.* Free bulletin describes ways to cut maintenance cost using plastic steel. (Page 167)

A-4-274-2—Plug Gages—*Dundick Tool Works, Inc.* Information available on the deluxe "Tri-Lock" reversable plug gages. (Page 274)

A-4-198-2—Thread Chasers—*Eastern Machine Screw Corp.* Information on insert chasers and free booklet "Unified and American Screw Thread Digest" available on request. (Page 198)

A-4-172—Abrasive Belt Grinders—*Engelberg Inc.* Production case histories using Engelberg abrasive belt grinders described in new brochure. (Page 172)

A-4-248-2—Carbide Cutting Tools—*Essex Rotary File & Tool Corp.* Catalog 9A describes complete line of Essex solid carbide rotary cutting tools. (Page 248)

A-4-204—Milling Machine—*Famco Machine Co.* Features of the Famco milling machine described in new catalog. (Page 204)

A-4-53—Dial Indicators—*Federal Products Corp.* Full line of Federal dial indicators described in catalog 58. (Page 52-53)

A-4-241—Gear Shaping—*The Fellows Gear Shaper Co.* Advantages of the gear shaper are described and illustrated in "The Art of Generating with a Reciprocating Tool." (Page 241)

A-4-224-1—Countersink—*M. A. Ford Mfg. Co., Inc.* Bulletin No. 702 describes the Ford Uniflute countersink. (Page 224)

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A-4-12 — Chucking Lathe — *Gisholt Machine Co.* New bulletin 1213 describes the complete line of Gisholt Masterline automatic production lathes. (Page 12)

A-4-34 — Milling Cutters — *Cutter Div. Ingersoll Milling Machine Co.* Complete line of Ingersoll inserted blade milling and boring tool described in catalog 66F. (Page 34)

A-4-221 — Progressive Dies — *B. Jahn Mfg. Co.* — Typical examples and applications of progressive dies described in B. Jahn brochure. (Page 221)

A-4-58 — Tracer Lathe — *Jones & Lamson Machine Co.* Descriptive folder No. 5440 discusses the advantages of the J & L turret lathe for tracing. (Page 58)

A-4-228-2 — Tachometers — *Jones Motrola Corp.* Catalog 147-D describes Jones surface speed indicators. (Page 228)

A-4-242-3 — Induction Heating — *Lepel High Frequency Laboratories, Inc.* New Lepel catalog contains 36 illustrated pages of valuable information on induction heating. (Page 242)

A-4-252-2 — Carbide Cutting Tools — *W. F. Meyers Co., Inc.* New cutter catalog No. 52 contains data on the complete line of carbide tipped and solid carbide cutting tools. (Page 252)

A-4-271 — Cylinders — *Miller Fluid Power Div. Flick-Reedy Corp.* Engineering bulletins on Miller air and hydraulic cylinders available on request. (Page 271)

A-4-193 — Hydraulic Check Cylinder — *Modernair Corp.* Free data bulletin describes the use of Veri-Trol checking cylinders. (Page 193)

A-4-184 — Marking Tools — *New Method Steel Stamps, Inc.* Brochure 500-C describes the advantages of NM model 500-C o-d marking tool. (Page 184)

A-4-228-1 — Hydraulic Clamps — *Newton Hydraulic Tooling Co.* Free catalog contains full scale templates and information on the Newton universal clamping system. (Page 228)

A-4-230 — Pressure Regulator — *C. A. Norgren Co.* Brochure No. 918 contains complete information on the pressure regulator for air, noncorrosive gases and liquids. (Page 230)

A-4-76 — Induction Heating — *Ohio Crankshaft Co.* Reprints of the article entitled "Buttwelder Leaves No Flash" now available. (Page 76)

A-4-252-3 — Auto-Collimators — *Opto-Metric Tools Inc.* Circular 85-200 contains complete information on the Leitz autocollimators. (Page 252)

A-4-31 — Air Units — *Hannifin Co., Div. of Parker-Hannifin Corp.* Literature available on filters, regulators and lubricators for the Crown air preparation units. (Page 31)

A-4-213 — Hydraulic Press — *Hannifin Co.* Complete data on the Hannifin "FD" presses for bench operations available in bulletin 132-A. (Page 213)

A-4-188 — Ultrasonic Cleaning — *Pioneer-Central Div. Bendix Aviation Corp.* Free report gives the principles and workings of sonic energy cleaning in detail. (Page 188)

A-4-217 — Clutches — *Rockford Clutch Div. Borg-Warner Corp.* Bulletin shows typical installations and applications of Rockford clutches and power take-offs. (Page 217)

A-4-181 — Turret Lathes — *Sheldon Machine Co. Inc.* Turret Lathe circular and general catalog describes complete line of Sheldon precision machine tools. (Page 181)

A-4-182 — Optical Measuring — *Simpson Optical Mfg. Co.* Free bulletin explains how the Vernac optical measuring instrument permits more precise work on present machine tools. (Page 182)

A-4-268-2 — Ball Bearings — *Southwest Products Co.* Engineering manual No. 551 has complete engineering specifications on "Monoball" self-aligning bearings. (Page 268)

A-4-75 — Machine Tools — *Sundstrand Machine Tool Co.* Bulletin 702 describes the complete line of Sundstrand machine tools. (Pages 74-75)

A-4-235 — Honing Machines — *Sunnen Products Co.* 99 case histories and data on honing production rates available in bulletin XSP-5075. (Page 235)

A-4-256 — Form Grinding — *The Thompson Grinder Co.* Engineering data available on crush formed grinding operations in catalog T-558. (Page 256)

A-4-224-2 — Hardness Tester — *Tinius Olsen Testing Machine Co.* Information on Tinius Olsen air-O-Brineli metal hardness tester in bulletin 52. (Page 224)

A-4-214 — Riveting Machines — *Tomkins-Johnson Co.* Reference data available on T-J Rivitors and Clinchors in bulletins 646 and 555. (Page 214)

A-4-252-1 — Air Fixture — *Union Mfg. Co.* Bulletin JTO-9-58 describes the Union Jato airborne fixture for heavy loads. (Page 252)

A-4-68 — Drill Heads — *United States Drill Head Co.* Catalog AD-57 contains data on adjustable drill heads for drilling and tapping. (Page 68)

A-4-253 — Tool and Die Steel — *Universal Cyclops Steel Corp.* New brochure No. TS-101 gives facts on Lo-Air cold work die steel. (Page 253)

A-4-44 — Carbide Tools — *Vascoloy-Ramet Corp.* Carbide grade selection guide simplifies selection of proper V-R standard grade for jobs, described in bulletin No. 5803. (Pages 41-44)

A-4-250 — Retaining Rings — *Waldes Kohinoor Inc.* 24 page catalog RR 10-58 shows solutions to design problems using Waldes Truarc retaining rings. (Page 250)

A-4-220 — Motion Picture Camera — *Wollensak Optical Co.* Detailed data on the Fastax combined motion picture and oscillographic camera available in bulletin FA-16. (Page 220)

A-4-277 — Workholding Arbors — *N. A. Woodworth Co.* Catalog 3-58 contains complete data on Woodworth standard arbors. (Page 277)

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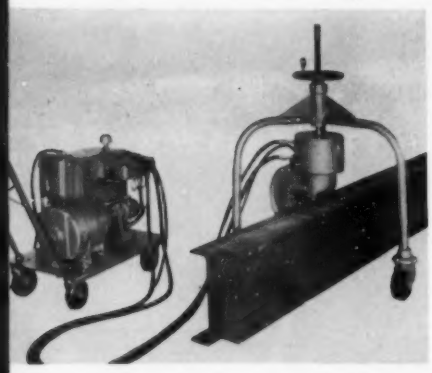


dexed from one hole to the other in a matter of seconds.

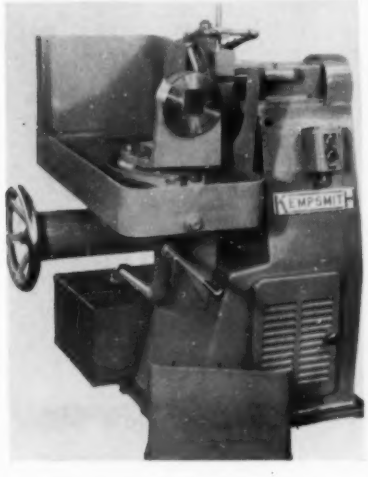
Larger units, with capacities from 50 to 90 tons, are equipped with back gages and a pointer on the punching unit. All that is needed is a scribed line across the part where a hole is to be punched.

Changing of punches and dies can be accomplished in less than two minutes, and there can be no problem of misalignment between the punch and die after replacement.

W. A. Whitney Mfg. Co., Rockford, Ill. **T-4-11**

Production Tool Grinders

Wheel mount end of the spindle of this heavy-duty production tool grinder is massively designed to furnish unusually strong support to the grinding wheel. Metal backed cup wheels are used. Tool bits to be ground are held in a double-swivel right-angle holder which permits grinding at all angles. The tool bit holder is mounted on a cradle which pivots on a large steel guide. The cradle is rocked past the face of the grinding wheel and is fed toward the wheel by turning the handwheel. A complete coolant system and adequate guards are provided.



Although the cradle is arranged for hand rocking, rocking by power also is available extra. With minor modifications, the machine can be used for production face milling of small nonferrous metal parts.

In use, relatively low skilled operators can grind from 1300 to 1500 tool bits per day. These tool bits ranged in sizes from $\frac{3}{8}$ x $\frac{3}{4}$ in. to 1 x 2 in. and the stock removed varies from $\frac{1}{8}$ to $\frac{5}{8}$ in.

The Kempsmith Machine Co., Milwaukee, Wis. **T-4-12**

Hydraulic Valve

This double hydraulic valve is available in three and four-way combinations in sizes ranging from 2 to 40 gpm with detented or spring return handles. Cem-Lap seals mating with optically flat rotor surfaces assure positive sealing at 2500 psi pressure for oil and 2000 psi for water and gas. The special seals prevent internal leakage and minimize maintenance problems. Motor starting switches can be added as shown for a-c or d-c operation; the pump then runs only when the handle

is turned. Rotor, seals and bearings can be replaced without disturbing piping or valve connections.

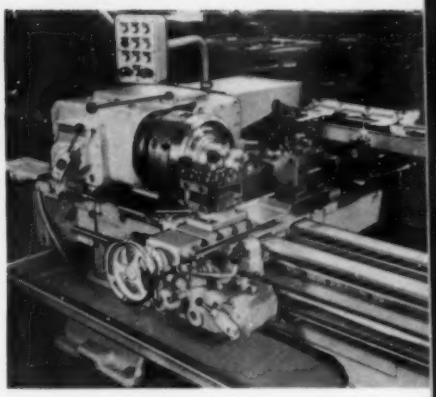
Clark Engineering & Mfg. Co., Inc., 1820 Layard Ave., Racine, Wis. **T-4-13**

Carriage Tracer For Turret Lathe

Four automatically controlled tracing cycles are offered by this hydraulically controlled tracer. It will trace through 180 deg of tool travel while turning, with feeding either toward or away from the headstock. It also will trace through 180 deg of tool travel while facing, with feed being either toward or away from the spindle center line. Roughing and finishing tracing tools can be used from the indexing square turret.

For either tracing or mechanical operations, complete size control for diameter is accomplished with the conventional, graduated handwheel.

It can be used as a taper attachment and, with a suitable threading device, will produce tapered threads.



Mounted on the rear of the cross slide carriage, the tracer does not interfere with normal operation of either the square or hexagon turret, or with tooling positioned at the rear of the cross slide. Templates and stylus are always in view of the operator and are clear and free from chips and coolant.

Feed limits are from ½ to 18 ipm. Feed can be changed by a single control, even while machining. Turning capacity of the tracer is the same as the mechanical capacity of the machine in 20-in. increments. Facing capacity in either turning or facing cycles is up to 6-in. radius change.

This tracer is available on the #7 saddle type machines, and with removal of the ram saddle on ram type lathes.

Jones & Lamson Machine Co., Springfield, Vt. **T-4-14**

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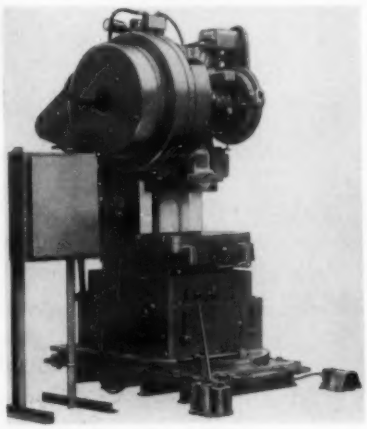
Cutoff Press

An air clutch control panel on this flying cutoff press synchronizes the press with the speed of the mill and permits cutting of any lengths of metal channels, bars, angles, mouldings, etc.

Designs of the base permits rotating



the press a full 360 deg while hydraulic power permits tilting it to any angle to form shapes. The press is available with or without the special base, and in any capacity up to and including 100 tons.

The one-piece cast iron frame has high tensile strength. The machine tool grade cast iron used in the frames has high compressive strength, while mass assures rigidity, high vibration dampening qualities and the ability to stand deflection without permanent deformation.

Federal Press Co., Elkhart, Ind. **T-4-15**

Power Attachment For Milling Tables

Rotary tables can be changed from hand feed to power feed in less than one minute with the Roto-Torque power attachment. It affords a smooth finish on special form work, such as radii, contours, cams or cavities with a minimum of hand polishing.

Adjustable speed control allows the table to be run at proper milling speeds —both forward and reverse.

M & M Tool Mfg. Co., 1124 East Third St., Dayton 2, Ohio. **T-4-16**

Pneumatic Planishing Hammer

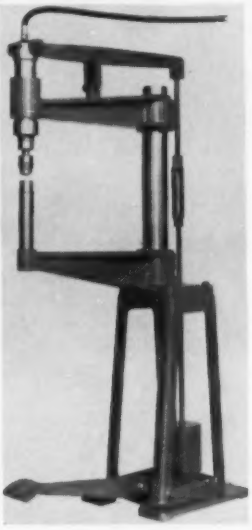
Model 200-RHP-18 pneumatic repeating hammer smooths out wrinkles in sheet metal. The floor mounted machine tool has 18-in. throat clearance. Operation is by foot pedal to bring the hammer cylinder down until the tool is in contact with the work.

Internal valving is actuated by contact pressure of the tool against the work. As long as this pressure is maintained the hammer will repeat at frequencies from 1500 to 3000 times per minute. Force of hammering action is

adjusted by regulating the air pressure.

The hammer cannot be triggered except by pressure of the tool against the work and is under the operator's control at all times.

Tools include planishing head integral with shank, and chucks to take standard or special tool shanks. The



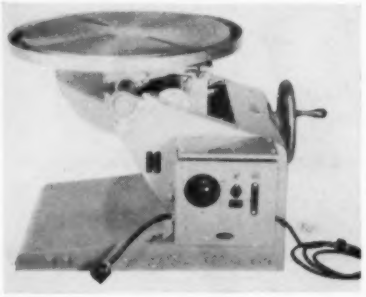
anvil is available in special, as well as standard, shapes and heights.

The machine is useful in a range of sheet metal work and in operations such as parts assembling, staking or riveting. For riveting, it has capacity to 5/16-in. diameter in mild steel.

Heidrich-Nourse Co., 631 E. Third St., Los Angeles 13, Calif. **T-4-17**

Turntable Positioner

Load capacity of this turntable welding positioner is 500 pounds at center of gravity 6 in. above the table surface and 3 in. off center of rotation. Infinite speed range is available from ¼ to 5 rpm. Table speed is constant, and direction of rotation is reversible. When the speed selector is in neutral position, the table can free wheel. The motor is a plug-in type which facilitates interchangeability. The control panel can



either be mounted rigidly to the frame of the positioner or it can be removed for remote mounting on a pedestal.

The table top can be tilted up to 135 deg while loaded. The table top is removable to permit use of tops that are fixtured for special jobs to be mounted quickly. A limit switch is provided for down limit protection when the tilt mechanism is mortorized.

Miami Specialties Co., Troy, Ohio. **T-4-18**

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Butt Welder

Model B-1 welder is capable of production butt welding of light wire parts with unskilled operators. It requires only inserting the two pieces to be welded in the clamping dies, operating the clamping and upset levers, and pressing the "operate" button. The

butt weld will be made automatically with precise alignment. Only a few seconds are required to make the weld.

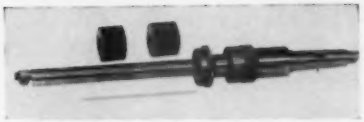
Because clamping dies and welding transformer are not water-cooled, the machine is recommended for light or moderate production applications.

Peer, Inc., 1220 Milton St., Benton Harbor, Mich. **T-4-19**

Recessing Tool

Accurate deep-hole recessing with extreme accuracy can be done automatically without a supporting jig with the JS recessing tool.

Used with a number of nose piece extensions to fit the part being machined, the tool is supported rigidly at the point of the work. This results in extreme accuracy in operations which heretofore



required extra handling to get the work completed from the opposite side or extra expense for supporting jigs and their use.

Maxwell's recessing tool was originally designed for and has proven most successful for machining parts where precision accuracy in deep holes with no cutter deflection is demanded. The tool, which can do any annular internal forming automatically, can be used with radial or horizontal drill presses, milling machines, jig borers, or various types of lathes. It is designed for working with or without fixtures. Equipped with relatively high feed ratios, it can be used with manual, mechanical or automatic feed.

This tool can also machine a multiple of internal forms simultaneously; with the use of spacers it can machine a series of forms in various locations in

the same piece with a single holder. Use of different diameters of self-lubricating bronze bushings, adapt the tool to a wide range of hole diameters.

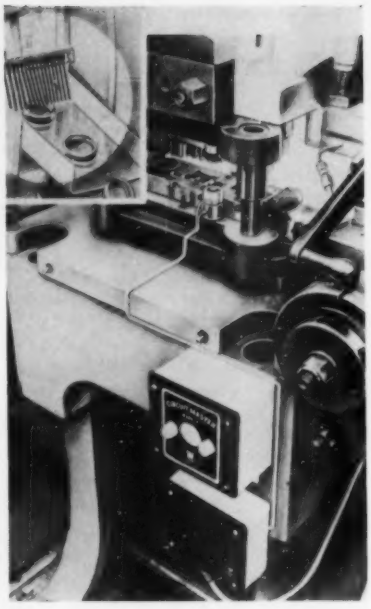
Spindle assembly is gear-rack-actuated. Feed ratio is approximately 7.5 to 1 which combines with positive feed of the eccentric cutter holder to assure good finish and precision. Ball-bearing stops prevent marring of either work or fixture. Diameter is controlled by stop collars threaded onto the body.

Maxwell Industries, Inc., 493 East Fifth St., Ashtabula, Ohio. **T-4-20**

Power Machine Protection Device

An electronic control unit called the Circuit Master Missing Parts Detector automatically disengages the clutch of a power machine when parts fail to eject. Auxiliary protection is provided against misfeed, buckling, overload and end-of-material controls.

The detection device, under control of Circuit Master Mark III, consists of a spring wire assembly that detects non-ejections, and shuts off power before damage can occur. The unit is automatic, requires no setting, supervision or adjustment.

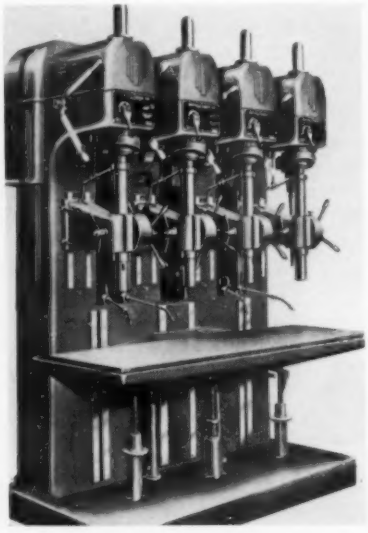


Wintriss, Inc., 20 Vandam St., New York 13, N. Y. **T-4-21**

Adjustable Speed Drill

This R-P-Mster adjustable speed drill incorporates an all-geared positive feed with a torque device on the feed shaft which is factory set for maximum torque. Overload causes slippage, preventing damage to the machine. No. 1A has 1 in. capacity in mild steel; No, 2A has 1½ in., and No. 3A has 2 in. capacity. The drill is available in one to six-spindle models.

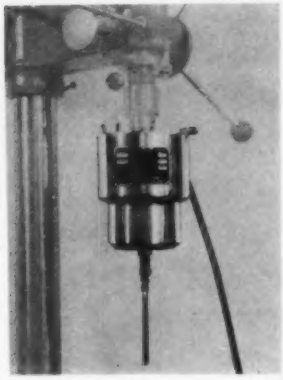
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. **T-4-22**



Metal Disintegrator

Broken taps, drills, reamers, studs, screws, etc. can be removed by a metal disintegrating machine which burns shaped holes into hardened metals. The tool also is useful for cutting keyways, extending oil lines or for missing operations.

This Model J-2 unit operates on an electromagnetic principle, which eliminates springs, drive pins, fiber pads, helical copper coils and solenoids. It has

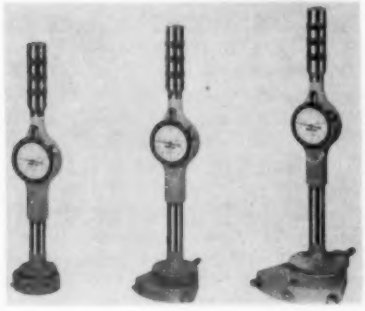


controlled drive and lift power, and sensitive vibration control for small diameter holes. It does not damage either threads in a tapped hole or the metal adjacent to the hole being made.

Jiffy Disintegrators, Inc., 1503 E. 11 Mile Rd., Royal Oak, Mich. **T-4-23**

Dial Bore Gages

No. 84 Series dial bore gages measure bore diameter in 0.0001 or 0.0005-inch units, depending on the model chosen, and will indicate variations



from true bore such as taper, out-of-round, bell mouth, hour glass or barrel shape.

The three sizes, covering a range of 3 to 12⅛ in. are available in six models. An adjustable and interchangeable, positive locking range screw provides simple adjustment for a wide measuring range. There is self-centering in the

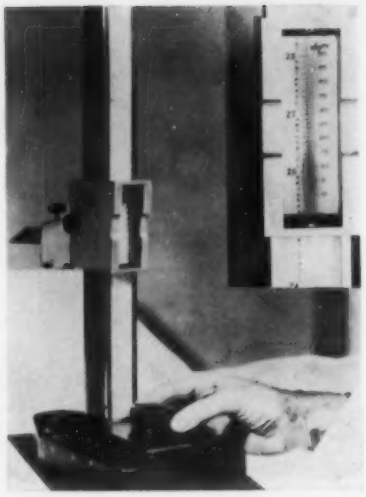
bore with two spring-loaded centralizing plungers; the range screw provides three point wall contact. Separate spring-loaded gaging contact assures accurate and reliable repetitive readings.

The L. S. Starrett Co., Athol, Mass. **T-4-24**

Height Gage

Quick and accurate reading of fractions of 1/1000 in. is possible with glass scale and glass vernier scales of the Tumico optic vernier height gage. Scale and vernier lines are machine divided and etched to be read from the rear of the gage. An inwardly curved chrome reflector behind the glass scale facilitates reading. The double-length vernier is 2.450 in. long and adjustable. Accuracy of the setting may be checked with standard gage blocks.

An H-beam is used for extra superior strength and rigidity, preventing sway and vibration. The sliding head moves through its entire range; a screw arrangement provides 100:1 ratio fine adjustment. Single pushbutton frees sliding head instantly for approximate setting. Lock knobs, on both sides of sliding head, provide for quarter turn solid locking of head to H-beam. Because of



the location of the fine adjustment screw on the base, downward pressure of the screw helps to hold the gage more firmly to the surface plate when making fine adjustments.

Gages 36 in. and larger are provided with additional fine adjustment knob on the top of the H-beam, for making fine adjustments standing up. A scriber clamp offers the use of all types of scribers for clamping above and below the jaw. It will hold scribers firmly and accurately, preventing loosening or changing scriber position.

George Scherr Co., Inc., 200 Lafayette St., New York 12, N. Y. **T-4-25**

Automatic Cutter Grinder

A single operator can operate more than one of these automatic cutter grinders which provide mechanical control of the grinding action to lengthen cutter life and improve accuracy and finishes.

The machine will do a complete sharpening job on a wide range of milling cutters, since it will grind on the OD as well as the face and bevel of any cutter within its 4 to 20-in. diameter capacity.

It spin-grinds newly filled cutters to size. A dust collection system is built into the machine and there is positive

dirt protection for moving parts. As the grinding wheel wears, the spindle speed automatically increases so that constant surface speed is maintained. The wheel is automaticaly dressed with every stroke.

Setups can be changed quickly from one size and type of cutter to another.

The Ingersoll Milling Machine Co., Rockford, Ill. **T-4-26**

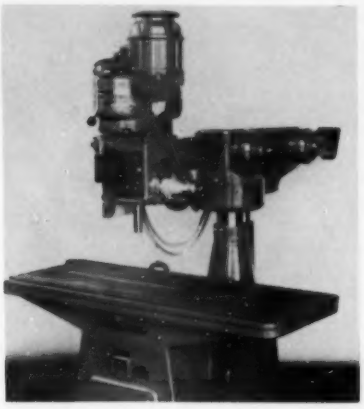
Radial Drilling Machine

Centralized single hand operation of the Mueller rapid radial drilling machine SR 23/BGC, minimizes the problem of drilling, boring, reaming and tapping holes up to 7/8 in. on awkwardly sized pieces.

Using the one central grip and a few

push buttons, the operator can swing from one location on to the other while raising or lowering the drilling head, or can reverse direction of rotation when tapping threads, or tighten the column and the arm.

All normal work can be drilled on the machine's table which is set transversely to the column. Particularly tall, awkward or bulky work can be placed behind the machine on the floor or on a



floor plate, and the drilling arm swung around to reach it. The machine also can be mounted upside down on a gantry above the erection floor.

The machine incorporates stepless speed control and drilling depth adjustment.

Carl Hirschmann Co., Inc., 30 Park Ave., Manhasset, L. I., N. Y. **T-4-27**

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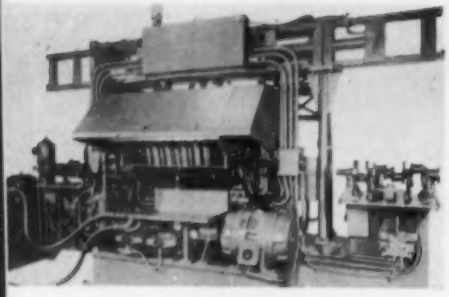
Finishing Machine

Lapping or roll burnishing bearing surfaces on crankshafts, or fillet rolling stress-concentration points at diameter changes is done by the automatic Footburt-Schraner Model SFB. Attachments also provide for lapping thrust surfaces. All lapping operations are performed by coated-abrasive belts. A hydraulically operated, automatic loading and unloading device equip the machine for use with integrated production lines. Crankshafts feed to the loading station from a conveyor, and loading and unloading stations, which position both axially and radially, are integral.

In one installation, the Model SFB laps all pin bearings, main bearings, and thrust faces, and roll knurls wiper grooves on an oil-seal diameter. Production is 60 pieces per hour at 80 percent efficiency. Resulting finish on the lapped surfaces is 5 to 7 microinch.

Thrust faces are lapped by narrow



coated-abrasive belts. To provide the proper lapping scratch pattern on the bearing surfaces, the headstock spindle, work and tailstock center oscillate past the lapping heads. Therefore, the thrust-face polishing attachments float freely on the lapping-head arms to follow the work and maintain continuous contact.

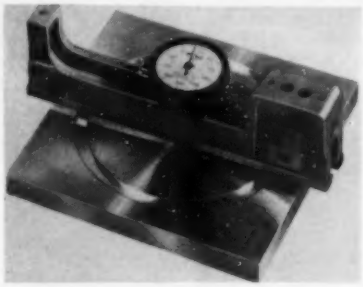
Knurling is done by a hydraulically actuated auxiliary head which rises from below the work. The fillets and bearing surfaces are lapped simultaneously. Fillet rolling is done in a separate operation, while roll burnishing is done after, or instead of, lapping.

Model SFB machine has a 15-in. swing and will accept work up to 36 in. long. Up to 16 heads can be provided; each can lap a bearing and a fillet and trust surface on each side. The hydraulic system provides 150 psi for lapping and fillet rolling, 300 psi for roll burnishing.

The Foote-Burt Co., Cleveland 8, Ohio. **T-4-28**

Shallow Bore Gage

The Model 14-323 shallow bore gage can be used to inspect inside-outside diameters to a depth of 1 in., from 1 to



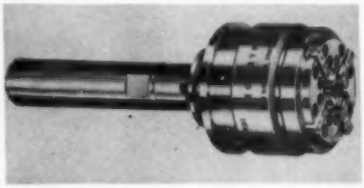
6 in. dia. The gage can be used as a portable instrument or bench mounted for special uses, such as hole location and length gaging.

Unigage Corp., Box 141, Downers Grove, Ill. **T-4-29**

Rotary Die Heads

Geometric KDI die heads can be converted from outside trip to inside trip by minor adjustments to provide an accurate length of thread from the end of the workpiece regardless of the chucking or location of the workpieces. This is because the inside trip will always reference from the end of the workpiece.

On larger sizes of the die heads it is



possible to provide reaming and chamfering tools attached to the end of the inside trip. These die heads can be closed by means of an operating yoke in the groove in the tripping flange of the die head. Provision also can be made to pass the coolant through the shank of the die head.

The Geometric KDI die heads are available in seven sizes ranging from 5/16 to 2½ inch.

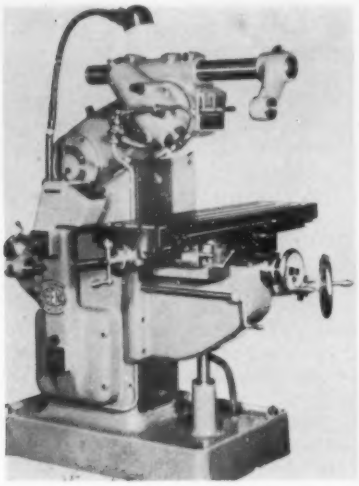
Geometric-Horton, New Haven 15, Conn. **T-4-30**

Vertical and Horizontal Milling Machine

Spindle head of the VHF-3 combination vertical and horizontal milling machine pivots at right angle lengthwise to the table and can be adjusted

at any angle, from 0 in horizontal position to 45 deg beyond vertical position. The slanting upper part of the column allows the spindle center or its front surface to stay at the same distance from the table, regardless of the vertical or horizontal spindle head position.

Although the machine is made to Swedish standards with a No. 4 M.T.



spindle, it also is available with other tapers.

The machine incorporates power feed controls of longitudinal, cross and vertical motions and a power rapid control for rapid feeds in all directions. There are 12 spindle speeds.

Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y. **T-4-31**

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Belt-Driven Wheelheads

Grinding small holes at precise surface speeds is possible with belt-driven wheelheads. The interchangeable cartridge type wheelheads develop spindle speeds of 45,000 to 100,000 rpm for grinding small diameter holes where surface speed of the grinding wheel is critical. Because there is no need for high-frequency generating equipment, these wheelheads permit economical

single high-speed spindle installation.

The interchangeable spindle cartridges are available. One operates at speeds of 45,000, 52,000 and 60,000 rpm; the other at 70,000, 85,000 and 100,000 rpm. Three separate speeds for each cartridge are obtained by pulley change. Both cartridges have spindles arranged to accommodate mounted point wheels.

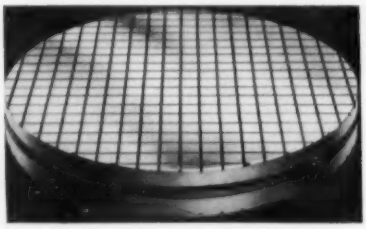
Ease of cartridge interchange and simplicity of changing from one speed to another within the range of each cartridge make the application of high-speed, belt-driven wheelheads practical where frequent setup change-overs are necessary. The wheelheads are particularly suited to long production runs.

The basic wheelhead consists of a jackshaft and body unit and the spindle cartridge. A spring-loaded damped idler puts constant tension on the spindle drive belt; its design eliminates vibrations caused by idler bounce. The grinding spindle is oil mist lubricated. The wheelheads are built with 4-in. center height as standard.

The Heald Machine Co., 6 New Bond St., Worcester 6, Mass. **T-4-32**

Lapping Plate

Precision grinding on both sides of this lapping plate gives it a double life. The 8-in. round by 1-in. thick plate has half-round grooved edge to facilitate

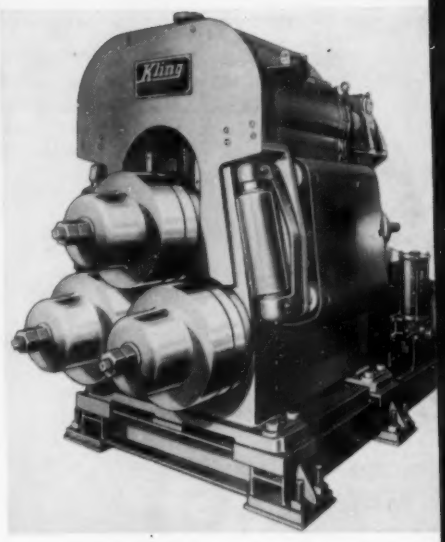


handling and lifting. Stress relieved to prevent warping, it is precision lapped to the three plate system. It is grooved 0.045 in., 3/8 in. apart, 1/16 in. deep on both sides.

Products Engineering and Manufacturing Co., Dwight St., Holyoke, Mass. **T-4-33**

Angle Roll Bender

The pyramid type angle roll bending machine is built to roll material in a horizontal or vertical plane. The vertical bender is available in four sizes and is designed for bending light, medium and heavy section of angles. The horizontal bender is designed for extremely heavy sections of structural material for rolling to large diameters; there is no need for unusually high head room. The two styles are designed with



heavy-duty capacity within safety factor of its design and include double frame housings with compact transmission. A tilting roll feature prevents distortion of flat bars when rolling on edge. A positive mesh gear train assures proper centering.

Kling Brothers Engineering Works, 1320-32 N. Kostner Ave., Chicago 51, Ill. **T-4-34**

Tool and Cutter Grinder

Model 3/Zn Pear tool and cutter grinder for three dimensional pantographs is designed to facilitate setting of the special tools efficiently. It will cut any concentric or eccentric type of shape by rotation of the axis of the tool in relation to the material to be worked.

With the machine it is possible to sharpen the tool giving it the required geometrical shape and giving its profile the right clearance according to the work. It also is possible to get sharp profiles having cylindrical shape, cylindrical shape with round angle, cone-shape, truncated cone, with round ex-

tremity, spherical shape, etc. All angular and linear movements which determine such shapes are fixed by special verniers and thus it is possible to resharpen the tool several times without altering the original shape.

Mandrel of the dimensional pantograph can be inserted in the support to allow sharpening of the tools in the middle of the rotation of the mandrel. By this system of sharpening it is possible to get very small work points centered accurately. By a pendular arm with a diamond, it is possible to dress the grinding wheel.

Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y. **T-4-35**

Band Saw

A carbide-tipped band saw, capable of cutting tempered foam glass and other abrasive or hard to cut materials, may be used on existing vertical and band saw machines, hand or power fed. No additional equipment is required.

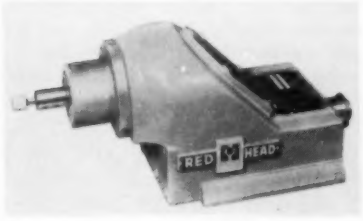
In use, the saw has produced 1200 cuts per blade in 12 x 5 x 4 in. tempered foam glass blocks.

Atkins Saw Div., Borg-Warner Corp., Indianapolis 9, Ind. **T-4-36**

USE READER SERVICE CARD ON PAGE 175 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Thread Rolling Attachment

Model B5 thread rolling attachment for use on the No. OO B & S single spindle automatic affords diameter capacity from 0 to 5/16 in. and a maximum thread length of 1/2 in. The two roll attachment is adjustable and self-compensating. Free floating movement of the B5 Head in the cross slide



adapter provides parallel alignment of the thread rolls with the center line of the work throughout the entire rolling cycle.

An advance compensator allows rolls of the same diameter to be used interchangeably, while a precision micrometer gage is used in setup for accurate positioning of the attachment in relation to the work.

Reed Rolled Thread Die Co., 791 Main St., Holden, Mass. **T-4-37**

Field Notes

With the dedication of its new plant in Phoenix, Ariz., General Electric Co. has effected a consolidation of its computer activities. Although G-E has been in the computer business for many years in that several of its departments have developed computer products for military and industrial customers, the company only recently established a computer department of its own in order to bring a concentrated effort to bear on solution of complex industrial problems through use of advanced computer technology.

Department functions, including all manufacturing operations, are now carried on in office and factory facilities occupying 176,000 sq ft of space in four locations in the Phoenix area. Other buildings currently under construction will provide an additional 87,000 sq ft of factory area. The company also has an engineering and laboratory facility which is located in Palo Alto, Calif.

Production from the department will include computer equipment designed for process control, data logging and data processing that can be coupled to process instrumentation in on-line operation or used in off-line work. A data acquisition system for process monitoring uses both analog and digital components as required, while other computer equipment serves a multiplicity of data control functions.

In all, according to company marketing manager George A. Hagerty, industry estimates show a 1959 sales volume of about $800-million, while a projection indicates 1968 sales will soar near $2.3-billion.

Under a grant of $36,500 from the Air Force Office of Scientific Research, a study of ductile fracture of metals will be made at Illinois Institute of Technology. The program will probe laws governing failure of metal when it is drawn out or hammered thin. Director of the investigation will be Dr. N. H. Polakowski, professor in the metallurgical department.

new divisions

Fenn Mfg. Co. has formed a Nuclear Products Div. to manufacture nuclear reactor components on a subcontract basis to existing primary reactor builders. Fenn vice-presidents will head the new division. A separate machining, fabricating, chemical and surface treatment facility was established, representing a substantial capital investment in highly specialized machines and equipment.

v v v

Burroughs Corp. has established a Military Electronic Computer Div. with headquarters in the company's defense plant on Tireman Ave. in Detroit. According to present plans, construction will start soon on a new $2-million engineering and administration building to provide 130,000 sq ft of space. In addition two factory buildings across the street from the plant have been acquired.

Formation of a Metals Div. was brought about by National Research Corp. as the result of an internal reorganization to consolidate production and marketing of the company's high purity tantalum and its alloys and other rare metals and related chemicals. The new division centralizes responsibility for production, product development and sales of tantalum products.

v v v

H. K. Porter has further expanded its operations with establishment of a twelfth manufacturing division. The new Mouldings Div. will manufacture and market the complete line of automotive and other metal moldings formerly produced by Herron-Zimmers Moulding Co. whose plants in Detroit, Mich. and Frankfort, Ky. were purchased by Porter.

expansions

Approximately $2-million is being invested by Stauffer Chemical Co. to expand and modernize its Niagara Falls plant. The project, scheduled for completion later this year, will add about 25 percent to the company's production capacity.

v v v

The Carborundum Co. plans to build a $¾-million pilot plant for its Research and Development Div. in Niagara Falls. From 9 to 12 months will be required for construction of the building, procurement and installation of equipment. The plant will provide the special equipment necessary to bring new products through their research and development stages to a point where they can be allocated to present divisions for production and sale, or where they can form the basis for new operation divisions.

v v v

A $5-million-plus expansion and modernization program has been completed by the Permaglas Div. of A. O. Smith Corp. Included in the plan are $550,000 office addition, $115,000 warehouse, $105,000 research and test facility, modernizations and additions to existing manufacturing plants, all in Kankakee, and acquisition of a water softener plant in Omaha and a water heater production plant in another marketing area.

association news

A committee on engineering information services was formed by the Engineers Joint Council in response to a provision of the National Defense Education Act. The committee will review and evaluate present systems for abstracting, indexing and distributing technical information, and present to the council a recommendation on steps to improve such services.

v v v

Aircraft Castings Assn. has been formed by a group of steel foundries to promote increased use of ferrous castings for aircraft, missile and related industries. Headquarters for the organization is in Los Angeles. According to its first president, Allen M. Slichter, the group also aims to achieve and maintain uniform high standards of quality for its products, and also wants to promote increased research and development of ferrous castings for aircraft, missile and related applications.

v v v

The Industrial Heating Equipment Assn. has formed an Industrial Oven Div. The organization now is composed of four groups—the other three being the Furnace Div., the Induction and Dielectric Div. and the Combustion Div.

v v v

English translations of German and French industrial standards are being made available in the United States through the American Standard Assn. Currently, a group of 175 German standards has arrived, and an additional group of 57 standards will be available soon. These are published by Deutscher Normenausschuss, the German national standards body. Subjects

covered by the translated specifications include screws, washers, nuts, bolts, test methods for steel and various nonferrous metals, welding, plumbing fixtures and inch-millimeter conversion.

The ASA also has received translations of 30 standards from the Association Francaise de Normalisation, the French national standards body. Subjects treated in these standards include zinc alloy ingots, blast furnace cements and conveyor belting.

v v v

Funds have been granted to the Engineers Joint Council by the National Science Foundation to review existing foreign language technical dictionaries and glossaries. For principal consideration are the Russian-English volumes. The Council then will prepare a report on deficiencies of existing works and make recommendations for a coordinated method of obtaining adequate, usable, technical coverage and maintaining dictionaries up to date.

new activities

A complete cutter and tool sharpening service has been added by the Cutting Tool Div. of Brown & Sharpe Mfg. Co. The new customer facility, called The Brown & Sharpe Cutter Service Co. of New Jersey, has been established at 590 Grand Ave. in Ridgefield, N. J. as an independently operated business staffed by trained cutting tool specialists.

v v v

Pratt & Whitney Co., Inc. has become an official sales agency for the line of precision lathes manufactured by The Wade Tool Co. The equipment will be made available through P&W factory-direct representatives working out of the company's branch offices.

v v v

Beaver Industries has developed a special repair service for Brown & Sharpe screw machines to meet the need of plants without special equipment or qualified personnel for such spindle repair. Information on the service is available from the company's Dept. 42, 1500 W. Adams St., Chicago 7.

v v v

Sigourney Mfg. Corp., in South Acton, Mass., has started production of investment casting employing modern vacuum metallurgy. Glass-ceramic investments are combined with vacuum casting in a high vacuum system of induction heating. Castings in steel, cobalt, nickel or nonferrous metals are produced under precisely controllable and exactly measurable vacuum melting and pouring conditions. The up-to-date

plant is equipped with the latest in wax injectors; special-design, programmed, ceramic burn-out ovens; precise vacuum and temperature controlled furnace, complete with optical pyrometer.

v v v

A contract manufacturing service for deep hole drilling operations on production run or small lot and experimental work is being offered by Edlund Machinery Co.

agreements

Hastings Plastics, Inc. finalized agreements with Reichold Chemicals, Inc. designating Hastings as a marketing outlet for Reichold's line of basic polyester, polyurethane and phenolic resins for aircraft and missile applications in southern California. The agreement also permits sales to other industries on a cooperative basis with Reichold's field personnel.

v v v

A licensing agreement has been concluded by Uniworld Research Corp. of America with Thompson Ramo Wooldridge, Inc. for exclusive production of castings of SR (Super-Rustfree) steel alloys. Thompson's Kolcast Div. now will produce SR castings by their frozen mercury investment process, and Thompson has exclusive right to sublicense the use of the steels in the entire casting field for such as sand, shell and centrifugal castings.

corporate changes

Announcement from Rome Cable Corp. and Aluminum Co. of America made public plans to affiliate. Under the agreement between the two companies, Alcoa will acquire all properties of Rome Cable for 355,226 shares of Alcoa common stock. The firms then plan to combine their electrical conductor, conduit and accessory activities in a new company to be called Rome Cable Co. Present members of Rome's management will continue in their present capacities in the newly formed company.

v v v

Stockholders have ratified purchasing agreements between the boards of directors of Allis-Chalmers and S. Morgan Smith Co. The exchange involved more than 430,000 shares of Allis-Chalmers common stock at a 1.1 to 1 ratio for Smith common outstanding. The transaction was made with unissued A-C stock. After acquiring the S. M. Smith assets, Allis-Chalmers announced establishment of an Hydraulic Div. Its production facilities include the two plants S. Morgan Smith op-

erated in York, Pa. where production and shop office space under roof occupy more than 230,000 sq ft. The York facilities will be devoted to continued research, design, engineering and fabrication.

v v v

Brown & Sharpe Mfg. Co. has purchased Howe & Fant, Inc. which becomes a subsidiary to be known as the Brown & Sharpe Turret Drilling Div., Inc. It will continue to operate at the East Norwalk plant with present personnel. Acquisition was by stock purchase. Distribution of products of the new division will continue through Howe & Fant's existing dealers in the United States.

new facilities

Techline Div. of Wheelabrator Corp. has opened a new chemical laboratory in conjunction with the processing laboratory at the Vicksburg plant. Included in the setup will be facilities for research and development in the field of barrel finishing compounds.

v v v

With the formation of Dietzgen of Canada by the Eugene Dietzgen Co. of Chicago, a new coating plant and warehouse has been opened at 5304 Fifth St., S.E., in Calgary, Alberta, Canada. A complete line of the company's engineering and drafting instruments and supplies will be distributed throughout the Dominion through exclusive arrangements made with Riley Reproductions, Ltd. in the western provinces; Instruments (1951) Ltd. in the eastern provinces, and the W. J. Dick Co. in Manitoba.

acquisitions

Entire line of Reed-Prentice lathes and millers was purchased from Package Machinery Corp. by The Black Rock Mfg. Co. of Bridgeport, Conn. which will continue to manufacture, sell and service this line. The name of Reed-Prentice will be maintained.

v v v

Saco-Lowell Shops has entered the electronics field with the purchase of the stock of Servo Dynamics Corp. of Somersworth, N. H. A. R. Abbott, president of Servo Dynamics, continues as operating head of the firm which now becomes a subsidiary of Saco-Lowell.

v v v

The Kellogg specialty alloy steel manufacturing business was purchased from The M. W. Kellogg Co., subsidiary of Pullman Inc., by Firth Sterling, Inc. Under the agreement, Firth Sterling acquired all patents, inventories and

production facilities of the Kellogg ingot process. According to present plans, operation will continue at the current plant location in Jersey City, N. J. without interruption to production and shipping schedules. Except for R. K. Hopkins, who will have enlarged responsibilities as a vice-president of Firth Sterling, personnel connected with the operation will continue in present capacities.

v v v

Complete business of Cast-Master, Inc. recently was acquired by Koehring Co. Purchase price, involving an exchange of stock, was reported in excess of $1½-million. According to the announcement, plans call for continued operation of Cast-Master in its leased plant at Bedford, Ohio, as a division of Koehring's Hydraulic Press Mfg. Div.

name changes

The company which has been known as Michigan Drill Head Co. has changed its name to Michigan Special Machine Co. According to company president Jerome Sullivan, expansion and diversification has necessitated a name more descriptive of present activities. There has been no change either in personnel or basic operating policies.

v v v

The Detroit Blue Print & Supply Co. now is operating under the name of Eugene Dietzgen Co. of Michigan, as a wholly owned subsidiary of Eugene Dietzgen Co. of Chicago.

moves

The Bettinger Corp. has moved into a new building designed and equipped for volume production of ceramic-on-metal products. The $1½-million, 100,000-sq ft facility, located in Milford, Mass., provides capacity for full scale, high automated production.

v v v

The western regional sales headquarters of the Alloy Tube Div. of The Carpenter Steel Co. has been moved from San Francisco to 2304 Huntington Dr. in San Marino, Los Angeles.

v v v

Harvey Aluminum has moved into larger sales engineering offices in San Diego, Calif. at 426 Olive St. to keep pace with increase in area activity.

v v v

Move to new and enlarged plant quarters at 3322 Hudson Ave. in Union City, N. J. has been completed by Kahle Engineering Co. The transfer was accomplished in stages to avoid disruption of manufacturing.

TOOL ENGINEERING in Europe

By M. Kronenberg
Consulting Engineer
Cincinnati 6, Ohio

New Tool Life Tests

Tool life data are usually collected and determined on the basis of keeping the cutting speed constant until a certain wear land or depth of crater has developed. L. Tschirf and E. Eder extend the application of determining tool life to machining operations with varying cutting speeds in an article published in *Werkstatt Technik und Maschinenbau*, Vol. 48, No. 4, pp. 193-198. The title is: "Standzeit eines Drehmeissels bei veranderlicher Beanspruchung."

They make use of a fictitious mean cutting speed, rendering it possible to retain the form of the mathematical equations for constant cutting speed. Tool life is also a fictitious quantity under these conditions. In this way they arrive at an equation involving the ratio of the wear land after the first and the K_n cut. If the cuts are different, it is necessary to measure the wear land each time. The authors conclude that the square root of this equation must be smaller than 1.0 if the tool is dull and ready for regrinding after the K_n operation.

Cast-Iron Ways

Cast-iron machine tool guideways are more common abroad than in the United States. For this reason K. Mueller has limited his investigation to two sorts of cast iron, although many of the principles discussed would also apply to hardened steel ways.

Mueller's findings are reported in "*Werkstatt und Betrieb*," Jan., 1959, under the title: "Ueber den Einfluss der Oberflaechengestalt und Oberflaechenbehandlung auf das Verhalten von Gusseisen in Gleitfuehrungen."

Basically two different types of wear occur: attrition and temporary welding of the contacting surfaces. Attrition is inversely proportional to the microhardness of interface crystals. The

harder the crystals, the less the volumetric attrition. Attrition with particles torn out of the metal freely moving between the surfaces, is less responsible for the wear of guideways than the welding and friction.

The author discusses—in great detail—the formation of electrons that fill up the space between opposite crystals, and also describes the reason for the increase in the size of porous portions in cast-iron guide ways. Atmospheric oxygen reacts with freshly formed fractures of microscopic dimension in an accumulating fashion until the stresses exceed a limit value. "Explosive cratering" results.

The stick-slip process occurring at low speeds has likewise been investigated by Mueller. He concludes that stick-slip is caused by vibration and affected by the resilience of the drive system with great mass and the elasticity of the surface layers of the crystals of small mass.

The surfaces were observed with an electron microscope and wear determined with the aid of a specially built apparatus. Conclusions are drawn for the design and surface treatment.

Loads on Steel Balls

Hardened steel balls are used not only in ball bearings but also in numerous other applications such as joints and guideways for machine tools. While the load conditions for ball bearings have been thoroughly investigated, data are lacking for the other cases, according to an article published by K. H. Kunert and H. H. Schreiber in *Werkstatt und Betrieb*, No. 1, 1959, under the title: "Die Belastbarkeit gehäufefer Stahlkugeln." The authors have investigated the upper and lower limits of fracture, elastic deformation and plastic deformation.

They conclude htat the load carrying capacity must be determined according to elastic and plastic deformation limits, rather than according to a certain percentage of the load causing fracture. This latter concept is unreliable due to the fact that it is dependent on the hardness and shape of the mating part. Numerous data are given in the article for the selection of material, loads and of other items as a function of elasticity and plasticity.

Cold Fitting

An introduction into the application of the liquid nitrogen for producing press fits was published by P. Zorner in *Werkstatt und Betrieb*, Vol. 91, No. 10, pp. 621-624 under the title: "Die Herstellung von Schrumpf Verbindungen durch Unterkuehlen in fluessigem Stickstoff."

The author says that this method permits a great temperature difference between outer and inner member. Computation of the press fit is made in the same way as in the case of warm shrinking methods; the reduction of the coefficient of thermal expansion in the case of cold shrinking must, however, be taken into consideration.

Subzero shrinking, it is claimed, has several advantages in comparison with warm shrinking or combined warm-cold shrinking procedures. Among them is the absence of changes in the workpiece, such as cracks, deformation or changes in microstructure. Subzero shrinking in liquid nitrogen does not affect a preceding heat treatment of the material. The temperature differences of 360 F and more are large enough to cause large shrinkage. The method is fast and simple. Liquid air and liquid oxygen require special safety controls which are not necessary in the case of liquid nitrogen.

Improving Tool Life

Life of high-speed steel tools can be increased many-fold by partial heat treatment of that surface of the tool which is subjected to the maximum load under cut. Lathe tools are treated in this way at the tool face, dies along the cutting edge. E. Hanke reports on his investigations in *Fertigungs Technik*, Vol. 8, No. 2, pp. 53-59. The title of the article is: "Standzeit Erhohung durch partielle Haertung mittels elektrischer Entladung."

Either alternating or direct current can be used, although better results are usually obtained with direct current. The tool is used as the cathode parallel to a condenser and the electrode is used as the anode and connected with the rotor of a vibrator in such a way that the electrode approaches and recedes from the tool in an oscillating fashion. Thirty, 60 or 90 volts are applied at a capacity of 8, 16, 54 or 88 microfarad. The electrode is usually made of cemented carbide tool material.

The carbide, however, is not transferred to the tool. There are no sparks but an arc at a temperature above the melting temperature of the tool material. The microstructure is changed at the tool surface and chilled by the cold mass of the tool. Hence a partial heat treatment is obtained with the hardened surface adjacent to an annealed layer.

The author claims that this layer increases the resilience and plasticity of the tool surface and reduces the formation of cracks and craters. Microhardness test data are included for different types of electrodes (tungsten, carbide, armco-iron, graphite) and also X-ray data on the microstructure produced under various cutting conditions.

Trade Literature

for free booklets and catalogs—use request card, page 175

Machining Stainless Steel

Eight-page bulletin presents machining data for stainless steel; includes tabulations of feeds, machining speeds, and grades of carbide cutting edges best suited for roughing, semifinishing and fine finishing 188 compositions of stainless steel types; also discusses austenitic, ferritic and martensitic stainless as well as tool geometry and coolants. Dept. SS, Kennametal Inc., Latrobe, Pa. **L-4-1**

Bearing Lubrication

Data and information on various types and brands of oils and greases available to bearing designers and users presented in 25-page illustrated lubrication manual by Robert F. Irwin of company's research and development laboratory; deals with subjects such as oil and grease lubrication, their properties, military specifications, standards and special lubricants; also includes blending charts, nomographs and other data. Miniature Precision Bearings, Inc., Precision Park, Keene, N.H. **L-4-2**

Molybdenum in Alloys

What abrasive wear is, its economic significance and how to combat it with molybdenum-containing materials are described in 36-page booklet. "The Role of Molybdenum in Abrasion Resistant Materials"; describes in detail three general types of abrasive wear and covers proper selection of material for particular types and conditions of wear; well illustrated with photos, charts and photomicrographs. Climax Molybdenum Co., Div. American Metal Climax, Inc., 500 Fifth Ave., New York 36, N.Y. **L-4-3**

Valves

Illustrated 20-page Catalog 59-60 describes line of manual, foot-operated and solenoid valves; color divisions permit quick reference according to type of medium used—oil, water or air—includes typical flow patterns and illustrations of specific valves, port sizes, ordering data and other pertinent information. Barksdale Valves, 5125 Alcoa Ave., Los Angeles 58, Calif. **L-4-4**

Grinding Wheels

Eight-page bulletin on grinding wheels discusses their five characteristics, offers hints for proper selection; also gives extensive list of grinding wheel recommendations, alphabetized according to material and job. The American Emery Wheel Works, Providence, R.I. **L-4-5**

O-Rings

Design and application of O-rings covered in 20-page Booklet AD-148 which discusses materials of construction, dynamic and static applications, use of back-up or nonextrusion rings, groove design. The Garlock Packing Co., 432 Main St., Palmyra, N.Y. **L-4-6**

Diamond Tools

Line of industrial diamond tools for general and special applications described and illustrated in 20-page catalog stressing importance to the tools of proper quality, size and shape diamond and formulation of special alloys and setting materials; also includes information on choice of correct tools, instructions for their use and care together with explanatory diagrams. A. Landau Co., 247 S. Ninth St., Philadelphia 7, Pa. **L-4-7**

Cobalt

First issue of *Cobalt* (which replaces monthly publication, *Literature Abstract Bulletin*) includes technical articles on "Uses of Cobalt" and "High-Temperature Alloys"; also contains 68 abstracts from current technical literature. Request only on company letterhead directly from Cobalt Information Center, c/o Battelle Memorial Institute, 505 King Ave., Columbus 1, Ohio.

Tooling Accessories

Complete specifications and data on more than 2,000 "standards" for tool, die, jig and fixture design and applications presented in 84-page catalog offered as concise data source; gives detailed specifications and engineering drawings with tracing templates available. Jergens Tool Specialty Co., 712 E. 163rd St., Cleveland 10, Ohio. **L-4-8**

Aluminum

Advantages of aluminum usage in heat-exchanger fabrication described in 16-page brochure containing charts and pictures and technical information; covers aluminum heat transfer rates, temperature properties, tensile strengths, pressures and dimensional tolerances, etc. Reynolds Metals Co., Dept. PRD-2. Box 2346, Richmond, Va. **L-4-9**

Brazing Stainless

Illustrated booklet on "How to Braze Stainless Steels" discusses characteristics of base and filler metals, brazing cycles, selecting and using gas atmospheres, and construction and application of various types of furnaces written by company's manager of process engineering, H. M. Webber. Harper Electric Furnace Corp., 39 River St., Buffalo 2, N.Y. **L-4-10**

Carbide Tools

Carbide blanks, inserts, tools and tool holders described in detail in 52-page Catalog 520 with complete price list; four separate sections clearly illustrated with keyed drawings and photos to provide detailed information quickly. Sandvik Steel, Inc., Coromant Dept., 1702 Nevins Rd., Fair Lawn, N.J. **L-4-11**

Worm Gears

Eight-page Folder, 2724, "Universal Worm Gear Speed Reducers," contains complete data on speed reducer designed to operate in three different positions, has high capacity with external fins for cooling, and is available directly from stock; tables give service factors, load classes, input horsepower ratings, overhung load ratings and thrust load ratings. Link-Belt Co., Dept. PR, Prudential Plaza, Chicago 1, Ill. **L-4-12**

Vibration Control

Full bonded tube form mountings and Dynaflex joints engineered for vibration and shock control described in 12-page product Bulletin No. 713; contains application guide, performance characteristics and data, detailed specifications, typical applications and methods used for selection and installation; extensively illustrated. Lord Mfg. Co., Erie, Pa. **L-4-13**

Meehanite Castings

Extensively illustrated, 32-page Bulletin No. 35, "Meehanite Castings Serve All Industry," provides users of castings with cross-section of scope of applications of Meehanite castings; covers most of major industry and gives table of physical properties of types of metals available. Request on company letterhead direct from Meehanite Metal Corp., 714 North Ave., New Rochelle, N.Y.

Ball Bearing Bushings

Sixteen-page Catalog 70-A contains engineering and ordering data for DieCo ball bearing bushing assemblies for die set applications complete with engineering drawings, specification tables and installation instructions. E. W. Bliss Co., Die Supply Div., 1400 Brookpark Rd., Cleveland 9, Ohio. **L-4-14**

Copper and Alloys

Pocket-size, 24-page Publication B-11D, "Copper & Copper Alloy Metalexicon", serves as handy "dictionary" for complex terminology applied to brass mill products, defining such terms as deoxidized, patent leveling, season cracking, yield strength, etc. Dept. SBR, The American Brass Co., Waterbury 20, Conn. **L-4-15**

Grinding Wheels

Complete range of sizes and shapes presented in 12-page illustrated Bulletin No. 7525 on grinding wheels; gives prices for every industrial application; also includes vitrified, resinoid and rubber bonds in cut-off, straight, recessed and plate-mounted wheels with recommended applications. Chicago Wheel and Mfg. Co., 1101 W. Monroe St., Chicago, Ill. **L-4-16**

Couplings

Illustrated 20-page Bulletin No. Q.S.R. 58 discusses three types of Titeflex Quick-Seal couplings; includes cross-section drawings to point out major features; extensive chart gives information for selection of seals for couplings in various temperature ranges plus flow data, pressure data etc. Sales Promotion Dept., Titeflex, Inc., Hendee St., Springfield 4, Mass., Titeflex-Pacific Div., 2328 Broadway, Santa Monica, Calif. **L-4-17**

Motors

A-c motor selector Bulletin B-2103-4 gives concise data of motors from one through 200 hp; the 12-page booklet includes brief explanations of NEMA design classes, speed-frequency relationship, current and torque values plus frame selection tables and dimension information for standard frames and mechanical modifications for all frame sizes; illustrated. Reliance Electric and Engineering Co., 23701 Euclid Ave., Cleveland 17, Ohio. **L-4-18**

Pneumatic Comparators

Line of air gages for dimensional measurement as well as series of automation building blocks for size control systems presented in extensively illustrated Catalog 8008; also covers recently standardized purchasing data on pneumatic plugs, rings and gaging cartridges; sketches on index tabs facilitate catalog use. Moore Products Co., H & Lycoming Sts., Philadelphia 24, Pa. **L-4-19**

Welding Wire

Comprehensive 4-page Bulletin DH-1218-0 comparing welding wire covers physical properties as welded; gives analyses, tensile strengths elongation and average Rockwell hardness numbers; also lists typical uses of gas welding rods, bare electrodes, automatic welding wire and metal spray wire. Page Steel and Wire Div., American Chain & Cable Co., Inc., Monessen, Pa. **L-4-20**

Test Cutting

Illustrated 11-page brochure describes two Demonstration-Test Centers for test cutting of actual workpieces submitted by customers to get accurate appraisal of cost per cut, tool life and production rates before purchase of a DoAll machine tool; illustrates and gives results of 28 actual tests. The DoAll Co., Des Plaines, Ill. **L-4-21**

Machine Tool Restoration

Ten ways to tell when a machine tool has lost original accuracy and should be rebuilt are outlined in four-page folder which also describes benefits that can be expected from rebuilding; illustrated with simple drawings. Gahr Machine Rebuilding Co., 19199 St. Clair Ave., Cleveland 19, Ohio. **L-4-22**

Maintenance and Repair

Helpful Data Booklet No. 21, "How to Make Your Own Machine and Repair Parts Quicker and Easier," covers care and trouble-shooting of machines and equipment, machining and welding techniques and also contains drill hole tolerances and grinding limits chart; presents many types of parts fairly universal in use throughout industry, and pictures them with descriptive case histories; also discusses pertinent machining problems. LaSalle Steel Co., P.O. Box 6800-A, Chicago 80, Ill. **L-4-23**

Modern Metals

Articles discussing important characteristics, uses and advantages of magnesium oxide, silicon carbide and zirconium alloys included in December, 1958 issue of company's publication, *Advanced Materials Technology*. Well illustrated with photos and graphs. The Carborundum Co., P.O. Box 337, Niagara Falls, N.Y. **L-4-24**

Barrel Finishing

Four-page illustrated folder describes line of 14 standard units, two small barrel models and 11 specialized barrel finishing machines as well as complete line of barrel finishing compounds and media; discusses design features and outlines specifications for typical machines. Almco, Albert Lea, Minn. **L-4-25**

Pneumatic Grinders

Data on line of portable pneumatic grinders (including the horizontal as well as the high-speed die grinders) incorporated in 12-page illustrated Catalog PT-58; includes selection tables plus information on auxiliary equipment and accessories such as wheels, brushes, wheel guards, etc. Thomas C. Wilson, Inc., 2111 44th Ave., Long Island City 1, N.Y. **L-4-26**

technical shorts

Finish Coating Provides Extra Qualities

A UNIVERSAL protective coating which may change industrial and consumer product finishing promises above average film strength, unusual resistance to chemical attack, high gloss and capacity for excellent adhesion to a variety of surfaces. The material, called Elastomer No. 614, is basically one part allophonate, prepolymerized. Field tests have shown it to provide a successful protection for magnesium indefinitely against that metal's inherent vulnerability to chemical and physical attack.

Conceivably, according to the developing engineers, at Howley Chemical Co., Inc., the new coating could serve in place of anodizing of aluminum. It requires no expensive equipment or plant. Primarily it is expected that spray application will be most widely used, although brush or dipping processes also produce good results.

◆ ◆ ◆

Develop Metal For Casting Flexibility

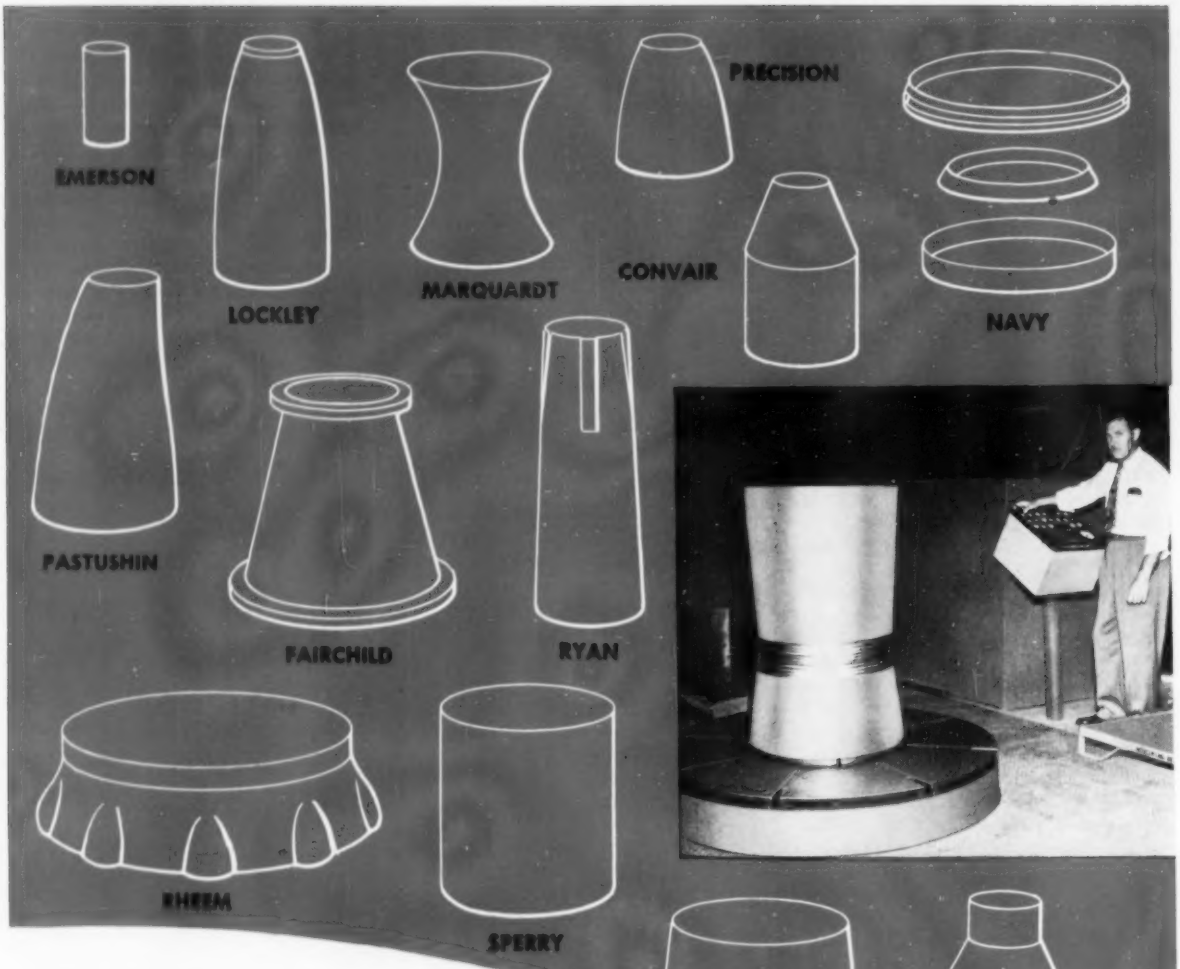
AN EXPERIMENTAL steel-like material that may prove a replacement possibility for plain steel forgings and permit design flexibility of castings was reported by General Motors at a recent American Foundrymen's Society conference. The material, called CentraSteel, was developed cooperatively by GM's Central Foundry Div. and Research Laboratories. According to the report of the developing engineers, it has a 28-million psi elastic modulus which is not altered by heat treatment, plus equivalent strength and better machinability. At the same time, castability seems to be superior to steel.

In consideration for foundry work, the new CentraSteel does not require extensive heat treatment, explosive addition agents, injection apparatus, or low maximum sulfur content. However, the researchers point out that some foundry problems remain to be solved for high volume production, but work on them is under way.

Source of the research program which resulted in CentraSteel was a search for a means of producing as-cast malleable iron. The outstanding characteristic is presence in the as-cast condition of a compacted type of graphite similar to the temper carbon of malleable iron. Absence of massive carbide permits its use in the as-cast condition. Although the high silicon-low carbon content is the reverse of normal iron founding experience, the proportion of carbon and silicon gives the metal high modulus and versatility.

Experimenters Open Path to Vanadium Alloys

SUCCESSFUL production of a series of vanadium alloys has been reached by Armour Research Foundation, which now makes possible a range of vanadium sheet as well as bars and forgings. Advantages of these alloys are their extreme workability, strength, and good weldability. Brought into use, they can be cold rolled over 90 percent as compared to gold's 99+. Among possible aircraft structural metals, it is a middleweight, yet its strength-to-weight ratio is superior to some of the lighter weight materials. The alloys retain their strength at temperatures of 1,200 to 1,500 F.



TOOL ENGINEERS say:
"form it on an

ARROWSMITH

HYDRA-SIZER"

.002 tolerance on diameter and contour is common on the Arrowsmith.

Machines ranging from 50 tons to 600 tons capacity are in use all over the world, forming and sizing material ranging from .032 to 3" in thickness and 10,000 to 200,000 psi tensile strength."

We will run your parts or build machines for installation in your plant.

Let us show you how the Arrowsmith will solve your sizing problems.

Technical information available.

ARROWSMITH TOOL & DIE CORP. 9700 Bellanca Ave., Los Angeles 45, Calif.

Men at Work

Charles F. McKenna, Jr., is new president of Johnson & Hoffman Mfg. Corp., subsidiary of Superior Tube Co., following the resignation of Jay H. Johnson. He previously was treasurer of the subsidiary.

Harold A. Johnson was elected vice-president in charge of engineering and manufacturing of Barnes Drill Co. He has served in various engineering and production capacities since joining the company in 1938.

A. J. McMullen who was vice-president of The Garlock Packing Co., was named president and principal executive administrative officer. He succeeds Robert M. Wapes who was elected chairman of the board.

Changes in officer responsibilities at Barnes Drill Co. have involved H. L. COGSWELL, and ROGER MARRIOTT. Mr. Cogswell, who has been general sales manager was elected vice-president in charge of sales and service activities of the machine tool, coolant cleaning equipment and honing divisions. Mr. Marriott, executive vice-president of the company, was elected secretary and treasurer to succeed Alfred G. Block who retired after more than 40 years of service.

WALTER E. STEWART, who has been manager of production engineering at The American Welding and Manufacturing Co., was recently appointed product engineering director.

HOWARD CARSON is new vice-president of Cadillac Gage Co. and general manager of the company's Costa Mesa operation. He has been in charge of the West Coast Div. since February 1957.

Society of Plastics Engineers, Inc. elected FRED C. SUTRO, JR. of Spencer Chemical Co. national president for the coming year. Other officers elected include GEORGE W. MARTIN of Holyoke Plastics Corp., who became first vice-president; JULES W. LINDAU, III of Southern Plastics, Inc., named second vice-president; FRANK W. REYNOLDS of IBM Corp., new secretary; and HAIMAN S. NATHAN of Atlas Plastics, Inc. who was made treasurer.

BEAUCHAMP E. SMITH, general manager of the Hydraulic Div. of Allis-Chalmers Mfg. Co., was elected a vice-president of the company. He formerly was president of the S. Morgan Smith Co. which recently became the York Works of Allis-Chalmers following a merger last January.

C. A. Norgren Co. recently announced that ZOLLY C. VAN SCHWARTZ had been made technical consultant. For the past 12 years, he was director of engineering standards for the Baldwin-Lima-Hamilton Corp.

Union Carbide Corp. has revealed appointment of WILLIAM B. NICHOLSON as vice-president of its Linde Co. division, and ROBERT F. FLOOD as vice-president-gas products. Mr. Nicholson, who joined the corporation in 1935, had been vice-president-gas products of Linde since 1957. Mr. Flood who also joined the firm in 1935, was formerly general manager-new products.

Promotion of ROBERT A. MANOGUE to the position of product manager, pumps and controls division, was announced by Denison Engineering Div., American Brake Shoe Co. He succeeds Ellis H. Born who was simultaneously appointed director of sales engineering for Denison.

DONALD E. SMILEY was named president of Pico Products Co., subsidiary of Pendleton Tool Industries, Inc. to replace ROGER H. STOKES who resigned. A veteran of 16 years experience with companies serving these industries, Mr. Smiley's most recent post was as vice-president-manufacturing of Weber Showcase and Fixture Co.

KENNETH M. GLESZER, president of Dixon Sintaloy, Inc., was elected president of Powder Metallurgy Parts Manufacturers Assn. He also is a member of ASTE's Fairfield Co. chapter. As first vice-president, the organization named M. T. VICTOR, president of International Powder Metallurgy Co.

Wallace S. Whittaker, formerly a production executive with General Motors, is new executive committee chairman of Pratt & Whitney Co., Inc. He also was elected board chairman of Potter & Johnston, a subsidiary.

Alfred T. Blackburn, formerly works manager, is now vice-president in charge of manufacturing at The Cincinnati Milling Machine Co. Clyde Eby, who was assistant works manager, succeeds him as new works manager.

Edward F. Whitney was named manufacturing vice-president of Sealol Corp. Prior to joining this company, he was general manager of Sealol Mfg. Co., a recently discontinued subsidiary of Sealol Corp.

JOHN E. NEWLIN, JR., formerly manager of tool steel sales for The Carpenter Steel Co., was named to fill the newly created post of general manager of sales service. Succeeding him is T. Allen Washburn who previously was assistant manager of tool steel sales.

Carpenter has also announced appointment of AVARD W. TAYLOR as general sales manager, Mill Product Div. He has been district manager of the company's Philadelphia and Atlanta territories.

At the stockholders meeting, ERNEST SWAIN was elected president and general manager of Dixie Tool Industries, Inc., and MILO SHANER was elected vice-president and assistant general manager.

CARL A. ANDERSON, former vice-president in charge of Minneapolis-Honeywell's Aeronautical Div. in Canada, has been named general manager of the company's recently acquired Marion Electrical Instrument Co. of Manchester, N.H.

At the annual meeting of the Cutting Tool Manufacturers Assn., GEORGE N. POPHAM of Gorham Tool Co. was elected president. He also is a member of ASTE's Detroit chapter. Other officers are KENNETH R. BEARDSLEE of Metallurgical Products Div. of General Electric, new vice-president; GEORGE R. SMITH of National Broach and Machine Co., re-elected treasurer and MARTIN J. EWALD who was re-elected executive secretary.

New president of Chrysler Corp.'s Amplex Div. is CARL J. DEMRICK. Former vice-president of Plymouth Div., he now succeedes G. W. Trichel who assumed new responsibilities as military advisor to the group vice-president-defense and special products.

D. F. GRIFFIN was appointed chief metallurgist of Landis Machine Co. He previously was associated with Vanadium-Alloys Steel Co.

FRANKLIN MEYER, JR. is now manager of the Small Tool and Gage Divs. of Taft-Peirce Mfg. Co. succeeding PAUL V. MILLER who retired to become consulting engineer for the firm. Mr. Meyer has been head of the Instrument Gage Div. since 1957.

American Coldset Corp. made public the appointment of HOWARD W. ARNOLD as general manager of all its divisions. Until recently he was associated with General Electric's Metallurgical Products Dept. where he was manager of product planning and marketing research.

Chemetron Corp. elected ROY T. OMUNDSON a vice-president. He is president of the company's recently formed Cardox Div.

Appointment of DUANE R. BRANAKA as general sales manager of The Sinclair-Collins Valve Co. and Valvair Corp., divisions of International Basic Economy Corp., has been announced. He will be responsible for supervision of marketing activities of both divisions.

At its annual meeting, The Aluminum Assn. elected M. M. ANDERSON president for the next year. He is vice-president of the Aluminum Co. of America. S. D. Den Uyl, chairman of the board of Bohn Aluminum & Brass Corp., was elected association board chairman. Two new association vice-presidents are John W. Douglas, president of Republic Foil and Metal Mills Inc.; and Thomas D. Gebhart, executive vice-president of Anaconda Aluminum Co. Frederick A. Marliss of United Smelting & Aluminum Co., Inc. was re-elected a vice-president.

good READING

MANAGEMENT FOR ENGINEERS—*By Roger C. Heimer. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. Price $6.75. 453 pages.*

The engineer engaged in problems which have precise mathematical answers is frequently not conversant with economic, social, psychological and political complexities of management. However, these subjects affect and often dominate the decisions of management. The book takes a practical look at the impact of costs, standards, materials, methods, taxes and insurance, power, equipment, labor and ethics on an organization. It shows the relationship between them and engineering considerations. The fundamentals of business cost consideration are described as well as how both cash and credit are made to work in behalf of the over-all business purpose.

ANALYSES OF INDUSTRIAL OPERATIONS—*Edited by Edward H. Bowman and Robert B. Fetter. Published by Richard D. Irwin, Inc., Homewood, Ill. Price $9.55. 495 pages.*

The various analyses that effect industrial operation have been combined into one volume. Many of the sections of this book have been published in the form of papers which were presented before various technical societies.

The book has been divided into five basic areas which are: the application of linear programming; other programming applications; waiting line applications; applications of incremental analysis; and total cost and value models. The studies include information on all phases of industry and such diverse things as data in the oil industry, manufacturing firms, warehousing, machine loading, production and personnel scheduling.

COMPANY CLIMATE AND CREATIVITY—*Based on a survey by Deutsch and Shea, Inc. Published by Industrial Relations News, 230 W. 41st St., New York 36, N. Y. Price $10.00. 107 pages.*

This book, based on a survey of various industrial organizations, shows the

effect of industrial environment on the creativeness of engineers and scientists. It is one of the important aspects of creativity in scientific and technical fields which is often neglected.

Most of the current interest in problems of creativity among technical personnel deals either with the individual or the team. However, many factors beyond the control of the creative individual enhance or inhibit his creative abilities. The most important of these is the internal climate of the company in which he works. This new study incorporates the ideas and opinions of more than 100 recognized authorities on creativity. It discusses in detail the elements which make up the company climate and its effect on the creative man.

THE ATOM AND THE ENERGY—*By Norman Lansdell. Published by the Philosophical Library, Inc. 15 E. 40th St., New York 16, N. Y. Price $6.00. 200 pages.*

The revolution in methods of energy production using atomics promises to have momentus effect on the whole of human life and society. Development of atomic power is likely to change the balance of world trade as well as relation of industry to state.

This book for the general reader helps to show the social and political implications of this scientific breakthrough. It will be useful to the business man who must adapt himself to the economy based on atomic energy.

Subjects covered include the atom, its energy and methods of releasing it, material sources of atomic energy, exploitation by separate countries and international bodies as well as the impact of the atom on the world as a whole.

THE SWISS AUTOMATIC—*Published by Andre Bechler, Lim., Moutier, (Switzerland) Machine Tool Works. Distributed by Bechler Service Corp., 28 Harvard St., Stamford, Conn. Price $12.00. 290 pages.*

Liberal use of illustrations and case studies describe the Swiss Automatic and its use. Theory of metal-cutting, the fundamental operations as well as the formation of chips by cutting tools are included. Other areas covered are steel, friction and lubricants, transmission belts, and the functions of the automatic lathe with sliding head stocks.

Theory is presented in an easy to read form which facilitates the understanding of complex engineering principles. An extremely important aspect of automatic screw machining—manufacture of cams—is covered in great detail. Examples of tooling on an automatic have part drawings, cam layouts, tool designs and analysis of operations to explain the important fundamental use of the equipment.

who's meeting and where

Apr. 6-10. AMERICAN WELDING SOCIETY INC. 40th annual technical meeting and welding exposition, Hotel Sherman, Chicago, Ill. For details, write to society office, 33 W. 39th St., New York 18, N.Y.

Apr. 7-8. UNIVERSITY OF WISCONSIN, University Extension Div. Engineering institute on Industrial product design. Write Dept. of Engineering, University Extension Div., University of Wisconsin, Madison 6, Wis. for more data.

Apr. 7-10. PURDUE UNIVERSITY and UNIVERSITY OF CALIFORNIA, Joint conference on numerical control of machines in production processes, presented by the two schools of engineering on Purdue campus. For more data write to dean of engineering at Purdue, West Lafayette. Ind.

Apr. 8-9. UNIVERSITY OF ILLINOIS. 2nd annual seminar on engineering drawing sponsored by Department of General Engineering and Division of University Extension. Obtain details from university, Urbana-Champaign, Ill.

Apr. 9-10. AMERICAN SOCIETY OF TOOL ENGINEERS. Seminar on analysis of metal cutting methods, Benjamin Franklin Hotel, Philadelphia, Pa. Get other data from Society office, 10700 Puritan Ave., Detroit 38, Mich.

Apr. 10-12. UNIVERSITY OF WISCONSIN, College of Engineering. Engineering exposition held on university campus. Further facts may be obtained from the university, Madison 6, Wis.

Apr. 13-15. AMERICAN MANAGEMENT ASSOCIATION. National packaging conference, Palmer House, Chicago, Ill. Also seminars at LaSalle Hotel, Chicago, Ill. Get more details from association office, 1515 Broadway, Times Square, New York 36, N.Y.

Apr. 13-15. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Hydraulic Division conference, University of Michigan campus, Ann Arbor, Mich. Contact society headquarters, 29 W. 39th St., New York 18, N.Y. for all details.

Apr. 14-15. ARMOUR RESEARCH FOUNDATION of Illinois Institute of Technology. Conference on industrial instrumentation and control, in cooperation with Professional Group on Industrial Electronics of Institute of Radio Engineers. Illinois Tech campus, Chicago. Get further details from R. W. Bull, supervisor of electronic instrumention, Electrical Engineering Research Dept., Armour Research Foundation, Chicago 16, Ill.

Apr. 18-22. AMERICAN SOCIETY OF TOOL ENGINEERS. Annual meeting, Schroeder Hotel, Milwaukee, Wis. All details are available from Society office, 10700 Puritan Ave., Detroit 38, Mich.

Apr. 20. NATIONAL INSTITUTE OF JIG AND FIXTURE COMPONENT MANUFACTURERS. First semiannual meeting, Detroit, Mich. Direct inquiries to Harold Wrigley, Vlier Engineering Corp., 8900 Santa Monica Blvd., Los Angeles 46, Calif.

Apr. 22-23. LEAD INDUSTRIES ASSOCIATION. 31st annual meeting, The Drake Hotel, Chicago, Ill. Institute office, 60 E. 42nd St., New York 17, N.Y., can supply more facts.

Apr. 22-26. METAL TREATING INSTITUTE. Annual spring meeting, Hollywood Beach Hotel, Hollywood, Fla. More information is available from institute headquarters, 420 Lexington Ave., New York 17, N.Y.

Apr. 26-30. NATIONAL SCREW MACHINE PRODUCTS ASSOCIATION. 26th an-

nual meeting, Hotel Roosevelt, New York City. More information may be had from association headquarters, 2860 E. 130th St., Cleveland 20, Ohio.

Apr. 28. AMERICAN SOCIETY OF TOOL ENGINEERS. Seminar on tooling for metal powder parts, Sheraton-Palace Hotel, San Francisco, Calif. All data is available from Society office, 10700 Puritan, Detroit 38, Mich.

Apr. 28-29. UNIVERSITY OF WISCONSIN, University Extension Div. Engineering institute on industrial applications of X-ray diffraction techniques. Get more information from the university, Madison 6, Wis.

Apr. 29-May 3. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metals engineering division conference, Sheraton-Ten-Eyck Hotel, Albany, N.Y. Obtain further data from society office 29 W. 39th St., New York 18, N.Y.

May 4-5. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Maintenance and plant engineering division conference, Edgewater Beach Hotel, Chicago, Ill. Society headquarters 29 W. 39th St., New York 18, N.Y., can supply details.

May 4-8. NATIONAL INDUSTRIAL PRODUCTION SHOW OF CANADA, Exhibition Park, Toronto. Further information is available from show management office, 19 Melinda St., Toronto, Ontario.

May 6. AMERICAN SOCIETY OF TOOL ENGINEERS. Seminar on optical tooling and gaging in manufacturing, Chase-Park Plaza Hotel, St. Louis, Mo. All details are available from Society headquarters, 10700 Puritan Ave., Detroit 38, Mich.

May 7. SOCIETY OF PLASTICS ENGINEERS, INC., Pittsburg Section. Regional technical conference on plastics and the metal industry, Penn-Sheraton Hotel, Pittsburgh, Pa. Write to John E. Parks, chairman, 35 Woodland Dr., Pittsburgh 28, Pa. for details.

May 7-8. UNIVERSITY OF WISCONSIN, University Extension Div. Engineering institute on adhesives and fasteners. Complete information may be had from Dept. of Engineering, University Extension Div., University of Wisconsin, Madison 6, Wis.

May 11-13. INSTRUMENT SOCIETY OF AMERICA. National power instrumentation symposium, Kansas City, Mo. For program information, contact H. H. Johnson, Consolidated Edison Co. of New York, Rm. 1515-S, 4 Irving Pl., New York 3, N.Y.

May 11-13. CONFERENCE ON AUTOMATIC TECHNIQUES, jointly sponsored by American Institute of Engineering Education, American Society of Mechanical Engineers and Institute of Radio Engineers. Pick Congress Hotel, Chicago. Information may be obtained from ASME office, 29 W. 39th St., New York 18, N.Y.

May 13-14. PORCELAIN ENAMEL INSTITUTE. Annual meeting, The Greenbrier, White Sulphur Springs, W. Va. Contact institute office, Associations Bldg., 1145 Nineteenth St., N.W., Washington, D.C. for details.

May 14-17. AMERICAN INSTITUTE OF INDUSTRIAL ENGINEERS, INC. 10th annual national conference and convention, Atlanta Biltmore, Atlanta, Ga. Get more data from the institute, P.O. Box 5255, Sta. E., Atlanta 7, Ga.

May 18-20. INSTRUMENT SOCIETY OF AMERICA. Fifth national symposium on instrumental methods of analysis, Shamrock-Hilton, Houston, Texas. Write to H. S. Kindler, director technical and educational services, ISA, 313 Sixth Ave., Pittsburgh 22, Pa.

May 25-28. DESIGN ENGINEERING SHOW AND CONFERENCE sponsored by machine design division of American Society of Mechanical Engineers. Convention Hall, Philadelphia, Pa. Complete information may be obtained from Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N.Y.

.....readers' viewpoint

. . . tool engineers' ideas needed

To the Editor:

In major surgery, the development of techniques and the possibilities have been outpacing the available tools. For instance, in a newly developed type of heart surgery, the major problem is bypassing the damaged artery during the operation, which must be performed within three minutes. However, with the bypass clamps available, the artery is crushed and damaged. This artery can be cut or pierced and will heal. Crushing, however, destroys it. A medical research group has appealed to me to assist them in developing a mechanical device that will not damage the artery.

If tool engineers are interested in donating their talents to medical engineering we will be glad to forward particulars.

L. DeVos
South Lyons, Mich.

ED.—Any ideas you might have to help solve this problem will be promptly forwarded to Mr. DeVos if mailed to THE TOOL ENGINEER.

. . . man-made diamonds

To the Editor:

On pages 177 through 179 of the February issue of THE TOOL ENGINEER, you have a digest of a talk by C. L. Fanning on man-made diamonds. We're happy to see this nice article, but would like to point out that the price per carat of man-made diamonds has been $2.96 per carat for quite some time now, not $3.48 per carat.

This makes quite a difference because the natural and the man-made diamonds now are within six percent of each other.

James Elovich
Metallurgical Products Dept.
General Electric Co.
Detroit, Mich.

To the Editor:

The prices quoted in my paper were those at the time of preparing my manuscript. I believe, however, that THE TOOL ENGINEER should acknowledge that the price has changed so that there is now but a few pennies difference. To give specific prices would again run the risk of being outdated within a few weeks or months.

Clyde L. Fanning
General Motors Institute
Flint 2, Michigan

NOW... you can get

TYPE No. 01 (A.I.S.I. or S.A.E. ANALYSIS)

FLAT GROUND DIE STEEL

OIL HARDENING

from SIMONDS

For tool makers, die shops and machinists who prefer or who have standardized on Type No. 01 Oil Hardening Steel, SIMONDS now offers the most complete range of stock sizes in flats and squares made from Simonds own steel of No. 01 chemical analysis.*

Precision ground and ready-to-use, all "1001" sizes are accurate and uniform in dimension and have an extra smooth surface with edges and ends finished and squared. Heat treatment is simple and foolproof, with excellent results assured. Best of all, you can get delivery now of No. 01 Type as well as Air Hardening and Low Carbon Type Flat Ground Steel from Simonds distributors' stocks backed up by Simonds warehouse stocks in Boston, Newark, N. J., Detroit, Chicago, Shreveport, La., Los Angeles, San Francisco and Portland, Oregon.

For Fast Service from Complete Stocks Call your SIMONDS Industrial Supply DISTRIBUTOR

SIMONDS SAW AND STEEL CO.
FITCHBURG, MASS

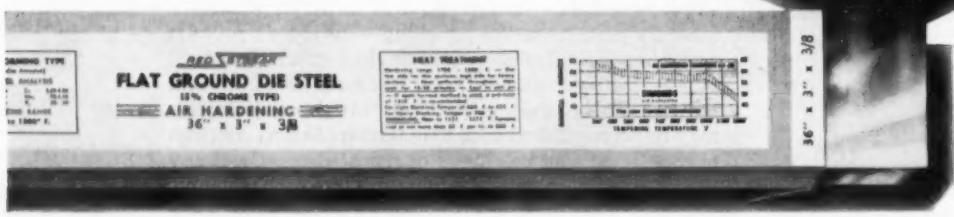
Factory Branches in Boston, Newark, N. J., Detroit, Chicago, Shreveport, La., Los Angeles, San Francisco and Portland, Ore. Canadian Factory in Montreal, Que., Simonds Divisions: Simonds Steel Mill, Lockport, N. Y., Heller Tool Co., Newcomerstown, Ohio Simonds Abrasive Co., Phila., Pa., and Arvida, Que., Canada

*

CHEMICAL ANALYSIS
Spheroidize Annealed —
Non-Deforming
Type No. 01 Oil Hardening
Flat Ground Die Steel

C	.85- .95	Cr	.40-.60
Mn	1.00-1.25	W	.40-.60
Si	.20- .40	V	.10-.20

Hardening Range —
1450° to 1500°F.



SIMONDS AIR HARDENING
(5% chrome)
Spheroidize Annealed —
Non-Deforming Type
Flat Ground Die Steel
Chemical Analysis

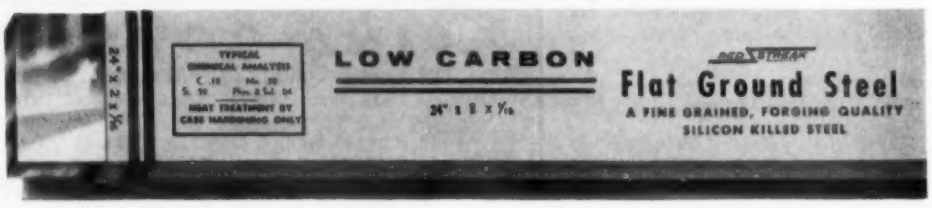
C	.95-1.05	Cr	5.00-5.50
Si	.30- .50	Mo	.90-1.10
Mn	.50- .70	V	.20- .30

Hardening Range —
1700° to 1800°F.

SIMONDS LOW CARBON
Fine Grained — Silicon Killed
Flat Ground Steel
Typical Analysis

C	.18	Si	.20
Mn	.50	S	.04
	P .04		

Can Be Case Hardened Only



Tech Digests

Shell Process for Investment Castings

By Ted Operhall

President
Misco Precision Casting Co.
Muskegon, Mich.

THE SHELL PROCESS will be a useful and practical system for producing castings, and will supplant the old massive monolithic type investment mold. While shells will not completely eliminate the other conventional process, it will play a predominant role with the investment casting companies in the future. It provides a host of advantages—the simple problem of handling raw material and mold storage—quality—and most important—cost, the most pertinent factor in maintaining a competitive position in our field.

The process provides for the manufacture of castings considerably more intricate and larger than has been produced heretofore. A major advantage is the ability to form a shell by a sequence of dipping operations, which precludes the need for flasks, vibration and bulk investment in order to form the mold. Further, the problems that result where flat surfaces of cored areas are present, which cause liquid entrapment, subsequent break-away of dip coat, and scrap due to inclusions and finning are also familiar.

A cluster of the vanes is now produced in a shell weighing only 18 lb, as opposed to an investment mold weighing 70 lb. The cycle time for producing shells has been greatly minimized. The preheat cycle for conventional molds normally takes 16 to 18 hours, whereas shell preheating is accomplished in 1½ hours.

The casting techniques are similar to these for conventional investment, and shells are poured under pressure without any backup. The operations from shakeout to shipping are the same as for the conventional process. However, significant improvements have resulted in surface quality and general cleanliness, with resulting reduction in finishing operations and scrap rates.

Another important aspect of the process is the ease with which it can be incorporated into an existing investment foundry. Cost of equipment is small in relation to the tremendous savings and increase in capacity that can be generated. Our slip coat operation, incidentally, is now in an area which was once used for bulk storage of sand and grog used for our conventional process.

Previous to the development of the process, production capacity was predicated on the number of molds that could be processed in a given day through a preheat furnace. This was the limiting factor due to the very long preheat cycle that was necessary.

For example, three 40 feet continuous furnaces had a production capacity of 600 molds per day. The installation of the present process in the area used for storge provides capacity of 400 shells per day, and we still have the capacity for 300 conventional molds per day. If the entire facilities were

Examination of the shells after the preliminary firing for evidence of defects. Ceramic shell is used for the casting of turbine blades in a cluster of six parts.

Approved shells are given the final coating, sprues are covered to prevent entry of dirt and are placed on racks ready for pre-heating and pouring of the molten metal.

Cast aircraft structural part of AMS5350.

converted, it is expected that our shell capacity could reach a level of 800 to 900 shells per day.

The rate of transition is determined to a large measure on the rapidity with which tooling can be changed. This is due primarily to the shrinkage differential of each of the processes.

One advantage which had not been anticipated, relates to the unusual stability of our shells in conjunction with many of the superalloys containing titanium and aluminum. Alloys such as CP 240, Udimet 500 and 700 and GMR 235, when poured in conventional investment usually develop surface oxide stringers. However, these are not in evidence with the process.

Another important factor is the improvement in physical properties of many of the alloys which, in many instances, has doubled stress rupture life due to the rapid solidification as the result of the unbacked shell. This, of course, is a definite plus factor when dealing with highly stressed components in the turbine section.

As stated the general transition to shell processes should come about within the next year or two in one form or another. While the process does not answer all the questions and problems which are found in our day-to-day dealings with casting manufacturing, it represents a significant improvement over conventional processes.

Based on a paper presented at the Technical Meeting in Muskegon, Mich., of the Investment Casting Institute, 27 E. Monroe St., Chicago 3, Ill.

▲ ▼ ▼

Vacuum Metallizing

By William Pahl

Manufacturing Research Engineer
Ford Motor Co.
Dearborn, Mich.

Vacuum metallizing is a process whereby a bright metallic film is condensed on a surface of an object in a vacuum. This object can be made of glass, metal, plastic, or a number of other materials. When the metallic film is condensed on the back side of an object made of a clear material and is viewed through the material, the process is called "second surface" vacuum metallizing. When the metallic film is condensed on the outer or primary surface of an object, the process is referred to as "first surface" vacuum metallizing. Second surface metallizing has been used by the automotive industry for many years, both on interior and exterior trim parts. The advantage is that the coating is protected by the overlay of clear material from wear, abrasion and the atmospheric elements. The moldings must be of a material that is water clear and has good light stability.

This discussion deals mainly with first surface metallizing of molded plastic parts.

First surface application permits the use of a variety of opaque plastics, metal stampings, die castings and certain other materials. The engineer now has at his disposal numerous materials with a wide range of physical properties from which to make his selection for designing interior trim parts which serve mainly a decorative purpose.

Although the use of first surface metallized finishes in the automotive industry is not extensive, a sufficient number of applications have been and are being used today to indicate that the finish has proven itself. There are numerous interior trim parts which are now chrome plated or only painted that a vacuum metallized finish could adequately replace. In many instances, steel stampings and die castings could be replaced by vacuum metallized plastic moldings at a considerable savings in material as well as processing and finishing costs. Another important fact which we believe will increase the use of metallized finishes on plastics as well as on metal parts, is the potential that color metallized finishes offer to the stylist. Practically any desired color tint can be had in this type of finish with only a slight increase, if any, in cost over the simulated bright chrome. It also is not unreasonable to assume that in the future the chemist will develop plastic materials with still better properties than those now available, and that the coating suppliers may develop coatings so durable that "first surface" metallized finishes can be used for exterior parts.

Based on a paper presented at the Regional Technical Conference of the Society of Plastics Engineers, Inc., 65 Prospect St., Stamford, Conn.

Solid Film Lubricants for Use Above 1000 F

By Ralph E. Crump
Chief Engineer
Electrofilm, Inc.

Since no conventional liquid or grease lubricant is effective above 700 F, solid film lubricants appear to be the only present-day solution to the problem. A solid film lubricant is a solid, fixed, thin film composed of solid lubricants of proven lubricity held together and in place by a suitable binder. Usually these films are less than 0.001 inch thick, and for "non-high temperature" applications the most popular solid lubricants are molybdenum disulphide and graphite. These solids are bonded together and to the surface needing lubrication by thermoplastic resins for air drying applications, and thermosetting resins for the heat-curing applications.

For solid film lubricants above 1000 F moly disulphide, with one exception, is not applicable. Above 800 F it oxidizes to the trioxide, which is abrasive.

The most successful formulas to date use so little frit that the end product is not glass like on the surface but grey-black, when graphite and lead oxides are used as the lubricant. As this field develops, and better solids are discovered, the compromise of graphite and lead oxide will no doubt be abandoned in favor of a single solid lubricant in a binder.

As research yields better high temperature solid lubricants and higher temperature binders they will undoubtedly be used to make existing products better, and to extend the temperature range now covered by these ceramic boneed solid film lubricants.

Based on a paper presented at the Annual Meeting of the Society of Automotive Engineers, Inc., 485 Lexington Ave., New York 17, N. Y.

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Remain Competitive

By A. F. Schroeder
Manufacturing Coordinator
Rockwell-Standard Corp.
Transmission and Axle Div.

To remain competitive in the months ahead will require careful planning and a good cost reduction program. There are a great many machine tools on the market today that will reduce direct labor cost, but a lot of the smaller plants have not been able to purchase much new equipment in the past eighteen months, so other means of reducing cost must be planned.

Have you a "Cost Reduction Committee," have you considered a committee made up of junior employees, perhaps a member of engineering, production control, cost estimating, material handling, inspection and an assistant foreman or setup man? This group should be given material such as trade magazines, and allowed to visit other plants. They should elect their own chairman, which office should be rotated. They should conduct their own meetings and submit their suggestions to management.

A few suggestions to pass along to your committee to give them a start:

1. Moving machines to obtain a flow of material so operations can be combined, or performed by one operator.
2. Design of fixture to accommodate more than one operation, either at one machine or by moving the fixture to the next machine without removing the part from fixture.
3. Burring operations as well as inspection operations can often be performed in connection with a machining operation within the cycle time of the machine.
4. Individual drill, tapping or milling heads can often be mounted on standard machines to perform such operations as drilling angular holes, milling slots, or tapping pipe tap holes, making it unnecessary to create a separate operation and handling of the part.
5. Chain conveyors with special hooks, baskets, or pigeonhole racks of either metal or wood can circle a few machines, including washing

and inspection, thus making stock boxes unnecessary. Another conveyor could start at the inspection bench where parts can be packed, boxed and conveyed to stock room, shipping room or to assembly line.

6. The so-called transfer machine can often be created by using standard machines, boring or drill heads, tapping or milling heads by mounting them on a fabricated framework and by use of rails fixtures can be moved from one operation to another. The job may warrant power moving of fixture and installation of limit switches thereby creating a semi or full automatic operation.
7. Mechanical devices can be created at a mill to length, and centering or cutoff machines transferring the part to the turning operation. Often one operator can handle both operations at the over-all time allowed for turning.
8. Tape controlled positions of table on a drill press can reduce fixture cost and speed up drilling operation on small-lot production at reduced cost.
9. Induction hardening of small parts or sections of larger parts can reduce over-all cost.
10. Combination operation and tool sheet can be used in almost any production shop—small or large. If complete it will reduce your inventory of tools as it encourages the operator to perform the operation with the tools provided, not leaving it to his own judgment on how to make the setup and perform the operation.

Based on a paper presented at the SAE Annual Meeting of the Society of Automotive Engineers, Inc., 485 Lexington Ave., New York 17, N. Y.

TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

Letter to the Editors

By Henry Dreyfuss
Industrial Designer
New York, N. Y.

Industrial designers make a living by thinking about the future. Though many products appear on the market just a year after we start work on them, others may have spent as long as ten years on our drawing boards. After that, a product's life may be measured in weeks or in decades. If it's a package, it may be thrown away as soon as

it's torn open. But if it's a bathtub, a farm tractor, a telephone, a machine tool or an airplane, it may be in use for 20 years. Add up these figures. You'll find that we're forced to spend a lot of our time thinking about what our products will be doing two or three decades after our first doodles are made on the back of an envelope.

I bring this up because the future is what my hosts have asked me to talk about. Without, I hope, sounding too much like the captain of a space ship, I'd like to take a brief look into the world that lies ahead of us.

One of the paradoxes of automatic production lines is that they require less sweat but more brains. Industrial training experts are already exploring the problem of upgrading workers' skills and educating future workers to deal with more complicated capital equipment.

However, only a few manufacturers of capital equipment are seriously considering how to make this increasingly elaborate equipment easier to operate. The study of the working relationship between a man and a machine is given the rather misleading name, "human engineering." Perhaps the most frequent human engineering problem in an age of automation will be control organization. How do you take a mass of knobs, buttons, switches, dials and designations and organize them so that a worker can operate his machine almost instinctively? Acres of automatic factory equipment mean acres of controls. And with all of this equipment functioning as a chain, a misread dial or the click of the wrong button can trigger off a costly chain of errors. Even with today's factory equipment, matching the machine to the man is a major problem; walk onto any factory floor and watch the workers fretting and squinting at their controls.

The essence of the problem is that manufacturers of capital equipment are going to have to meet workers halfway. While people are building their skills to deal with more complex tasks, we're going to have to build machines that reach out and help our employees do these jobs more efficiently and easily.

With all the talk of industrial automation, we're tempted to forget the home. When asked how they feel about husbands working four days a week, many housewives shrug. After all, homemakers still work a seven-day week. But if automation is successful in the factory, it will be successful in the home. Using the same punch cards that her husband uses at his job, a woman will literally set up a day's work in advance. She might even set up a week's work and go off to Paris for a long week end; her home will be running smoothly when she returns.

What can we automate in the home beyond our present pop-up toasters and self-regulating refrigerators? There's already been plenty of talk about automated cooking. But cooking is a very personal thing that not everyone may want to pass on to the machine. Cleaning, however, is something all housewives will be happy to forget. I believe we can look forward to having small, electrostatically controlled devices that we'll install in our ceilings or floors to collect and flush away the accumulated dust. For that matter, all appliances will be self-flushing; as electric garbage disposal units now remove our kitchen debris, an orange squeezer will flush away the pulp leaving the appliance clean and ready to be used again. Our cities' costly sewage systems might be eliminated; all waste may be incinerated on the spot by a solar unit.

Based on a paper presented at the 13th Annual Conference of the Society of the Plastics Industry, Inc., 250 Park Ave., New York 17, N. Y.

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Properties of Epoxy Adhesives at Elevated Temperatures

By Edward W. McGuiness
Laboratory For Electronics, Inc.
Boston, Mass.

The epoxy resins have very low shrinkage, excellent tensile strength and are free from inhibition. However, it is their ability to adhere tenaciously to practically all surfaces that make the epoxy resins vastly superior to other

resins. They give an excellent bond to all metal surfaces as well as other plastics and materials. Because of their low shrinkage, there are very few stresses built up during the curing of the adhesive. The polar nature of the epoxy molecule results in great strength between the molecular chains giving good cohesive strength. The combination of a strain-free resin with good internal strength combined with adhesive strength about equal to its cohesive strength gives a resin adhesive that is capable of its maximum properties.

The question might well be why is a good metal adhesive so important. We already can join metal to itself. However, the epoxy-resin adhesives have made possible an entirely new method of joining metal to metal, metal to plastic and plastic to plastic. This method of resin bonding in addition to giving a high strength bond also offers some other unique advantages.

1. Dissimilar metals and materials may be bonded.
2. Low-temperature curing of adhesive eliminates possibility of change in properties of materials being joined.
3. Equalized stress distribution over the mating surfaces can be obtained thus allowing use of thinner gage material.
4. Leak-proof joints are possible.
5. Galvanic corrosion is eliminated when dissimilar metals are joined.

The physical properties of the epoxy-resin adhesives may vary over a wide range depending upon the resin used and the curing system employed. In general, the room temperature cured materials while achieving a comparatively good strength without an oven bake will be much stronger after a short cure at an elevated temperature.

The epoxy resins are an excellent bonding material. They can exhibit a very wide range of properties depending upon the catalyst and curing agent use. Room temperature curing agents such as diethylene triamine give fair room temperature properties but poor hot and cold strengths. Curing agents such as diethylamine propyl amine or triethanol amine require a cure at a moderate temperature. They give greatly improved properties up to a temperature of 250 F. Dicyandiamide, in addition to giving a system with the catalyst and resin already mixed that has very long pot life, also extends the temperature at which it can be used up to about 300—350 F. Epoxy resins blended with phenolic resins give excellent strength retention at temperature of 400 to 600 F when catalyzed with dicyandiamide or hexamethylene tetramine. Most epoxy resins can withstand indefinite exposure to 250 F, some 300 F. At the present time, the life at temperatures over 400 F is more limited. Fillers can add to the high temperature strength. The adhesives can be made very flexible with good low-temperature properties or very rigid as the specific use would indicate. Great progress has been made in improving the physical properties and heat resistance of these materials in a relatively short period. At the present time, work on improving the heat resistance and high-temperature strength is under way which will probably result in improvement of both of those properties.

Based on a paper presented at the Epoxy Resin Symposium of the Society of Plastics Engineers, Inc., 65 Prospect St., Stamford, Conn.

TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

A Method for Determining the Tensile Properties of Metals at High Rates of Strain

By A. L. Austin
and
R. F. Steidel, Jr.
Univ. of Calif.
Berkeley, Calif.

An experimental method has been developed to determine the dynamic

tensile properties of materials at the high rates of strain experienced during the final stages of plastic deformation to fracture.

An explosive impact tensile tester has been designed with provisions for direct and accurate measurements of load, impact velocity and instantaneous changes of diameter as a function of time. A charge of gunpower is used to propel a projectile threaded to one end of the specimen, the other end being fixed.

A load-time history is obtained from an oscilloscope record of the output of two resistance wire strain gages mounted at the fixed end of the specimen. With silhouette lighting, a high-speed framing camera operating at 170,000 frames per second is used to photograph the specimen over the interval of time from necking to fracture providing a permanent visual record of the instantaneous change of diameter with time. By this method dynamic stress-strain curves are obtained for various true strain rates.

Based on a paper presented at the Annual Meeting of the Society for Experimental Stress Analysis, Central Square Sta., P. O. Box 168, Cambridge 39, Mass.

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European Investment Casting Techniques

By Roger F. Waindle
President
Wai-Met Alloys Company
Detroit, Mich.

Plants making blades and vanes are only in England and are not quite up to ours because they have not required such high production as we; plants making other castings are, on the average, as well organized and equipped as ours and often better. These other plants which I would like to call industrial product plants are characterized by good equipment and layout; they pack their flasks full of castings and tend to use larger flasks; they do not make our high quality, but aim more for highest production at lowest cost. Wages are as low as $0.60 per day for girls, $1.50 for men in Spain, to about $0.60 per hour in England and Germany. The bulk of the plants are Austenal licensees, all seem to be working on shelltype molds, but this is one item none of us actually saw in any plant.

Holland has, perhaps, one of the most unique conveyorized plants; at Phillips in Eindhoven, they reflect the Dutch use of canals and waterways by using a trough of water to convey wax patterns from the injection machines. They claim that in addition to conveying the patterns, this results in uniform temperature at the assembly point.

There is a real lack of knowledge of the use of water soluble cores and fewer plastic patterns used than would be thought from the class of work they turn out.

Specifications are looser than ours and even in aircraft work which is confined principally to England, there seems to be more dependence placed on the integrity of the foundry rather than the tightness of a specification.

The Shaw Process appears to be used mainly for prototype work—not for production. Sizes range from about three to 1500 pounds.

My over-all impression is that the Europeans have a tremendous respect for what we are doing, but actually, they are spending more time on studying problems to learn the "why" and "how" to control their processes than we are!

Based on a paper presented at the Technical Meeting in Muskegon, Mich. of the Investment Casting Institute 27 E. Monroe St., Chicago 3, Ill.

Electrical Properties of Epoxy Resins During Polymerization

By John Delmonte
General Mgr.
Furane Plastics, Inc.
Los Angeles, Calif.

Studies of the variation in electrical parameters during the polymerization of epoxy resins offer means for interpreting molecular changes occurring during the curing process, both before and after gelation. The mechanical changes which occur are numerous—an initial change of viscosity on the addition of curing agents, a rise in temperature due to exothermic reaction, and a final increase in viscosity, culminating in gelation. This pattern is well-known and characteristic of many epoxy systems. Other means for observing changes in the epoxy resins during the polymerization process involve the use of infrared spectroscopy where molecular changes are indicated by changes in the spectra of infrared transmission.

Changes of electrical properties in liquid epoxy resins both before and after gelation have always intrigued our research staff and, while admittedly our work is not sufficiently fundamental to interpret accurately the molecular changes taking place with the changes in electrical properties, observations are consistent and informative. To a physical chemist equipped with clearer concepts of the interdependence of electrical parameters and changes due to polymerization, the observations of dissipation factor during cure afford useful tools to enrich the understanding of these important processes.

As nondestructive testing procedures, electrical measurements are most revealing, leading to data that may help to interpret the polymerization process of the epoxies.

Based on a paper presented at the Epoxy Resin Symposium of the Society of Plastics Engineers, Inc., 65 Prospect St., Stamford, Conn.

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Dip Coats and Investments

By C. R. Whittemore
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Deloro Smelting and Refining Company, Ltd.
Deloro, Ont., Can.

Investment casting technique involves the casting of metals into a refractory

cavity which has been formed by the melting or dissolving out of a replica of the part (the pattern) to be cast.

The pattern may be wax, plastic, mercury or a low-melting point alloy. Wax and plastic are most widely used.

The refractory cavity may be formed by (a) coating the disposable pattern with a bonded fine-grained precoat, backed up by a bonded and relatively coarse-grained more permeable refractory, which technique is at the present time the most universal; (b) the formation of thin shells (3/16 to ¼ in.) produced by successive dippings or build-up by spraying, firing to remove the pattern and set the refractory. The shell may or not be backed up with a refractory material.

The fine dip coat produces smooth castings, but such results are not consistently attained, particularly with the high temperature alloys. Casting defects result from (1) the spalling or cracking of the precoat from the pattern or from the formation of fine cracks in the precoat during curing of the mold or on entrance of the metal; (2) reaction of the metal with the precoat material; (3) mechanical causes such as too thick a layer at one spot into which the stucco has not penetrated to provide a mechanical bond, (4) buckling of the dip coat which produces a dimpled surface or a metal skin overlapping the dip coat.

Based on a paper presented at the Technical Meeting in Muskegon, Mich., of the Investment Institute, 27 E. Monroe St., Chicago 3, Ill.

TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

Lateral Vibrations in Reciprocating Machinery

By C. M. Lowell
Engineering Supervisor
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Buffalo, N. Y.

Considerable investigation has been made of lateral vibration or "whirl" of shafts in rotating electrical, mechanical and hydraulic machinery. Tests dealing with lateral shaft vibration of reciprocating machinery, pointed out a coupling between torsional and lateral vibration. A test apparatus was used which made possible control of the variables involved. Heretofore, most investigations have been concerned with rotative speeds equal to fundamental frequencies. Experimentation has been confined to rotative machinery such as multistage turbines, centrifugal pumps and compressors and to electrical machinery.

Whirl is merely a lateral vibration superimposed upon rotation. Normal whirl in rotating machinery occurs at or near the corresponding rotative frequency. It is evidenced by rotation of the shaft in a bowed position like a skipping rope. Where no gyroscopic effect of the rotating masses is encountered this lateral natural frequency is the same for any speed. This would be the case for a mass-shaft system where the shaft is uniform and supported identically at both ends with the concentrated mass in the exact center. In the test apparatus to be described, the mass was overhung and, therefore, the whirling natural frequency was modified by the gyroscopic component.

The mass of the flywheel in the test apparatus deflects the shaft downward while the gyroscopic component tends to straighten it. Since natural frequency

is a function of deflection, the gyroscopic effect tends to decrease the deflection and thus raise the lateral natural frequency as the rotative speed is increased. This lateral or whirling natural frequency is known as forward whirl.

Reverse whirl is caused by a change in algebraic sign of the gyroscopic component. It acts in a direction which tends to cause the shaft to deflect still more than that caused by the flywheel mass. This causes a reduction in natural frequency as the rotative speed is increased. Reverse whirl can be observed if there are disturbing forces in the rotative system which coincide with the natural frequency of the reverse whirl.

Evidence has been found not only of whirl phenomena in reciprocating machinery, but of lateral vibrational harmonics similar to those found in torsional vibration of reciprocating machinery. This was particularly noted in reciprocating engines and compressors with overhung flywheels. Its presence could be detected with the naked eye by a "fuzzy" appearance of the flywheel rim as viewed perpendicular to the axis of rotation. Further evidence could be found by viewing the centering countersink in the end of the crankshaft. At certain speeds the countersink appeared to "dance" and its center traced a star-shaped figure. On compressors having direct-connected motors with overhung rotors a marked jumping of the end of the shaft could be noted.

This phenomenon was not found in all machines but only on certain sizes and numbers of cylinders. The one common denominator for all cases was the proximity of the torsional natural frequency to the lateral or whirling natural frequency of the flywheel-shaft system.

Since any vibration is a source of stress, a study was instituted to determine the causes, effects and remedies of this type of vibration under controlled laboratory conditions.

TO REQUEST COMPLETE PAPERS, WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

The conclusions drawn from the series of tests can be summarized as follows:

1. Any periodic torque applied to a shaft driving an overhung flywheel mass will tend to excite a lateral vibration or whirl in the elastic system.
2. When torsional and lateral natural frequencies of a mass-shaft system are close to each other, any periodic torque tending to excite a harmonic order, however small, of the torsional natural frequency will likewise excite the lateral natural frequency.
3. If possible, torsional and lateral natural frequencies should be separated as far apart as possible to assure no excitation of lateral vibration. This is particularly true if strong torsional orders occur within the operating range.

Torsional disturbances can cause lateral vibration in a shaft system as described in the foregoing. An overhung flywheel is particularly susceptible to this phenomenon because of its relatively low lateral natural frequency. The principal causes of cycle torsional disturbances are torsional vibration and cyclic irregularity. Both of these frequencies can be calculated readily in advance. Cyclic irregularity or torque variation will have a frequency which varies directly with rotative speed. If

the product of the number of torque variations per revolution and the revolutions per minute of rotative speed approaches the lateral natural frequency of the flywheel-shaft system, lateral vibration can result. In this instance, the torque variation will act in the same manner as torsional vibration.

Some crankshaft failures have been encountered which can be at least partly attributed to additional bending stress caused by whirl. Fortunately, either the torsional disturbance must be strong or the torsional and lateral natural frequencies practically in resonance before sufficient lateral vibration to cause trouble occurs. Small lateral vibrations have been observed in many types of reciprocating machinery, even when outboard bearings were used for flywheel support. No serious additional stress was caused because a condition of resonance did not exist.

Based on a paper contributed by the Machine Design Div. and presented at the Annual Meeting of the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

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Radiant Heat Transfer in Annealing Furnaces

By H. T. Bates

and

Takeshi Utsumi

University of Nebraska
Lincoln, Neb.

Present-day trends in the manufacture of metal sheets call for high-speed continuous annealing lines. Rolls of steel or aluminum sheet are fed into high-temperature furnaces, heated and cooled rapidly and discharged. Such lines are kept going by welding the ends of the rolls together.

In order to get the necessarily high rates of heat transfer, radiation is used. Convection is comparatively unimportant in such furnaces because the convection heat transfer rate is proportional to the difference of the first power of the temperatures. Radiation is important because the rate is proportional to the difference of the fourth powers of the absolute temperatures. Since some of these continuous annealing lines run as fast as 1000 fpm, large differences in temperature and considerable amounts of exposed area are essential.

Most furnaces operate without heat recovery. That is, the heating section contains a fixed hot body radiator of

more or less constant temperature and the cooling section contains a fixed cold body receiver kept as cold as possible and fairly uniform in temperature. All the heat needed by the sheet is put in, taken out, and them thrown away in the cooling water. This procedure reduces the area requirement to a minimum but consumes a maximum of heat. It is conceivable that fuel might someday become expensive enough to makes heat recovery economical. A heat recovery furnace would consist of three sections instead of two. The entering cold sheet strip would be exposed countercurrently to the hot sheet strip just starting to cool. In this section some heat would be extracted from the hot strip and transferreed to the cold strip. After leaving this section the cold strip would need to be heated further in a fixed hot body radiator section before returning to the countercurrent transfer section. The warm strip leaving the countercurrent section might need further cooling in third section of the furnace having a fixed cold body receiver. No external heating or cooling would be used in the countercurrent section. Thus the annealing furnaces would resemble heat exchangers for fluids except that heat transfer would take place primarily by radiation instead of by convection.

Based on a paper presented at the Second National Heat Transfer Conference of AIChE-ASME in Chicago, Ill. for the American Institute of Chemical Engineers, 25 W. 45 St., New York 36, N.Y.

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Progress in High Temperature Resins: Epoxy Novolacs

By D. D. Applegath
R. F. Helmreich
G. A. Sweeney
Dow Chemical Co.
Midland, Mich.

Results show that high functionality epoxy novolac resins have several advantages over epoxies derived from Bisphenol A. Advantages are displayed in laminate strength at elevated temperatures, heat distortion temperatures and chemical properties.

Special, but fairly simple techniques adapt these viscous, highly reactive resins to the usual casting, prepreg laminating, and coating applications.

Based on a paper presented at the Epoxy Resin Symposium of the Society of Plastics Engineers, Inc., 65 Prospect St., Stamford, Conn.

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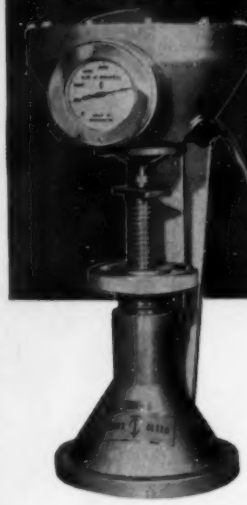

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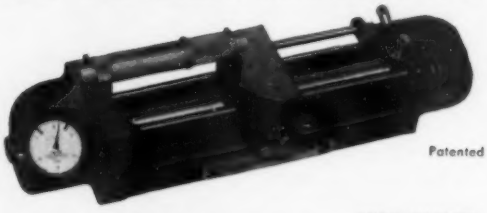

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Ex-Cell-O stocks more than 10,000 different standard size Drill Jig Bushings at key points throughout the country for same-day shipment to your plant regardless of location. Thousands of semifinished bushing blanks on hand speed orders for special sizes. Ex-Cell-O Drill Jig Bushings last longer because they're made better. Hole hardness is maintained at 62-64 Rockwell "C" with chrome-alloy bearing steel, heat treated with the most modern methods.

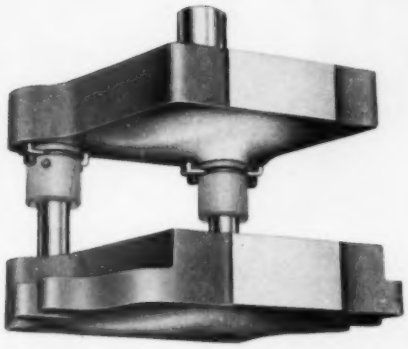
Order from the Ex-Cell-O Drill Jig Bushing inventory nearest you: Contact Ex-Cell-O Corporation in Detroit, New York, Downey, Calif., Cincinnati, Ohio and London, Canada. Write for Ex-Cell-O's Drill Jig Bushing Catalog today.

EX-CELL-O
CORPORATION
DETROIT 32, MICHIGAN
Machinery Division

EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • THREAD AND GROOVE GAGES • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

There's Always Something New at DANLY®

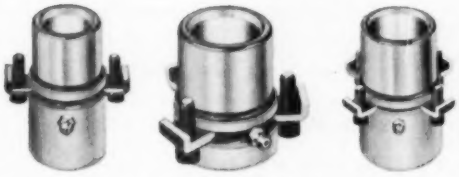
in DIE SETS



New Danly Demountable Die Sets offer you uniformity in a precision fit never before achieved in die sets. Danly Demountable Bushings seat with a tap fit, flush against the ground face of the punch holder with the bore perpendicular to that surface. They are *pre-fitted* in manufacturing so accurately that they are interchangeable. You get 100% bearing every time.

Bushings are easily removed for die work or grinding and returned to proper fit, always. Products of Danly's 36 years' experience, Danly Demountable Bushing Die Sets are stocked near you, giving you fast delivery from a local source.

in BUSHINGS



The New Danly Bronze Plated Demountable Bushings are recommended for use on all Die Set applications requiring high surface speeds, especially with side thrust loads. They are manufactured to the same degree of precision fit as hardened steel and bronze bushings. Factory pre-setting is extremely accurate and reliable . . . lets bushings and guide posts work interchangeably. Available in both shoulder and short shoulder design . . . also in shoulder guide post bushings.

in DIE STOPS

New 5/16" Die Stop completes a full Danly line. Economical, the stop is priced at a fraction of the cost of handmade versions. For easy-to-install, easy-to-use Die Stops, specify the "Big Four" of Danly. They're adaptable to all Dies. Other sizes include 3/16", ¼", and ⅜" bars, with arm extensions from 3" to 6".

in TOGGLES

New easy-grip Kwik-Klamp Toggle Clamp features plastic handle for more comfort and convenience. New fork bar is more versatile, stronger. The new clamps are available with either straight or flanged bases, and with swivel or universal adapters. It is the only toggle clamp available which can be adjusted to any compound clamping angle.

Look to Danly, the leading supplier in the stamping industry, for progress—for all that is new and modern in Die Sets and Die Makers' supplies. Send for information on Dowel Pins, Socket Screws, Bushings and Guide Posts, Roller Stock Guides, etc. Or simply contact your nearest Danly branch or distributor.

DANLY MACHINE SPECIALTIES, INC.

2100 S. Laramie Avenue, Chicago 50, Illinois

DANLY®

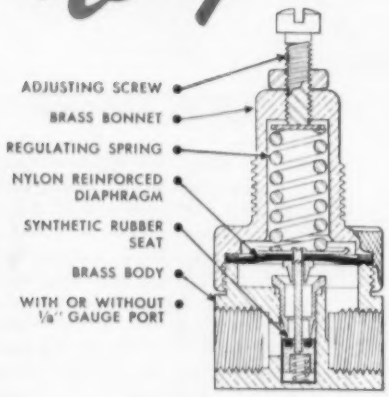
The leading supplier to the stamping industry

Die Sets • Die Makers' Supplies • Mechanical Presses

Norgren PRESSURE REGULATOR

⅛" and ¼" pipe sizes

For Air, Non-corrosive Gases and Liquids



Best performance of any Regulator this small

AIR FLOWS UP TO 20 cfm at 100 psi air pressure.

RELIABLE PRESSURE REGULATION even with widely fluctuating line pressure and rapidly varying air flow.

MAXIMUM PRIMARY PRESSURE: 400 psi.

MAXIMUM DELIVERY PRESSURE: 100 psi.

MAXIMUM OPERATING TEMP.: 200° F.

Compact

The small size of this regulator — only 3 1/32" high, with 1⅜" hex body diameter (without gauge) — makes it ideal for installations where space is tight.

Low Price

The lowest price ever for a top quality, dependable pressure regulator.

For complete information

call your nearby Norgren Representative listed in your telephone directory — or **Write Factory for Brochure No. 918**

If it's Norgren... It's Dependable.

Plus these important features...

- **Easy to Install** — In-line pipe connections. May be installed in any position.
- **Easy Maintenance** — Should service be necessary, the regulator can be quickly and easily disassembled without removing from line.
- **With or Without Pressure Gauge** — 1½" gauge, 160 psi full scale reading, back mounted.
- **Flow Direction** — Right to left or left to right.
- **Panel or Bracket Mounting Available.**

C. A. NORGREN CO.

3447 SO. ELATI ST. • ENGLEWOOD, COLO.

AIRBORNE *TACAN* DEMANDS THAT PARTS LIKE THIS FIT PERFECTLY, EVERY TIME

. . . and here's how ITT's Standards Lab makes sure they do

This heater and cathode contact ring assembly is used with a lighthouse-type electron tube in the airborne unit of TACAN, a military and commercial aerial navigation system.

As in all TACAN components, this mating part must be readily *interchangeable* in case of component failure. So Federal Telephone and Radio Company, a Division of International Telephone and Telegraph Corporation, turned to their Standards Laboratory *before* starting production.

The heater and cathode contact ring was *optically* inspected—on a Kodak Model 30 Contour Projector. After analyzing the results, minor changes in tooling were suggested. Result: a perfectly matched part, completely concentric and interchangeable.

Whatever you're inspecting . . . Whether it's tools, gages, dies, electrical or mechanical components, the Kodak Model 30 Contour Projector provides you with a projected image that's as *free* from distortion as the science of optics will permit . . . *accuracy* across the entire face of the big, 30-inch screen. Images are sharp, high-contrast; erect and unreversed at all magnifications. Changes in magnification can be made at the flick of a switch.

More refinements . . . You also get efficient head-on surface illumination and a full 16" throat clearance between collimator lens and front mirror. This clearance is constant at all magnifications, permits staging of large parts without repositioning.

The many other advanced refinements, extreme optical stability, and rugged construction of the Model 30 Kodak Contour Projector make it a leading choice for large-screen precision micrometry or routine gaging.

Cut inspection costs . . . Along with accuracy, optical gaging with Kodak Contour Projectors offers you savings in gage costs, increased inspection rates, and the economies that result from a minimum of operator training. You can use optical gaging almost anywhere in your plant . . . receiving, assembly, production, inspection, toolroom. There are 6 Kodak Contour Projectors to choose from, one matched to your inspection needs. Get all the facts by writing for our detailed catalog.

At the ITT Standards Laboratory, the Kodak Model 30 Contour Projector provides the accuracy needed for testing and servicing master mechanical and electrical measuring devices.

Special Products Sales

EASTMAN KODAK COMPANY, Rochester 4, N. Y.

the KODAK CONTOUR PROJECTOR

Kodak

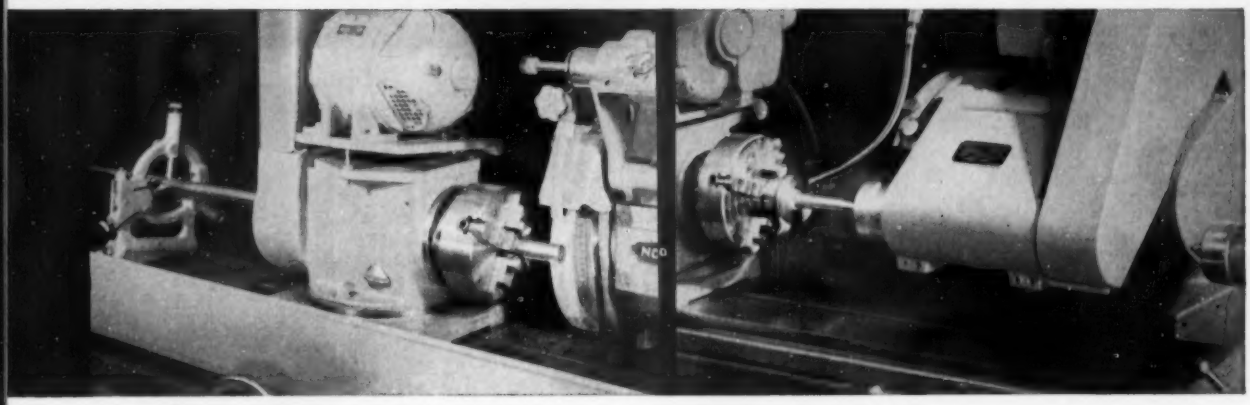
A Norton 12″ Type U-4 Universal Grinder, available with 36″ or 48″ nominal lengths between centers, typical of Norton Universals.

Install any Norton Universal Grinder and you've got a practically complete grinding department — for faster external, internal, face, taper and angular wheelslide grinding, including many special jobs. That's because Norton builds exceptional versatility into all these famous universals, with time-and-money-saving "Touch of Gold" advantages like the following:

Extremely rapid chucking . . . quick change-over to live or dead spindle operation . . . wide range of easily changed work speeds . . . independent wheel and feed settings for doing difficult jobs fast . . . extra capacities in wheel head and headstock . . . precise swivel table alignment with the SWIVALIGN* *Dual Electric Indicator and semiautomatic plunge feed arrangement optional extras.*

Engineered for long service life in handling so many different jobs, Norton Universal Grinders are easy to operate and maintain. Their swing capacities range from 10″ to 18″. Your Norton Sales Engineer, a trained expert in the grinding field, will be glad to help you select the size you need — and to give you an accurate estimate of what this grinder can do for you. NORTON COMPANY, Machine Division, Worcester 6, Mass. District Offices: Worcester, Hartford, Cleveland, Chicago, Detroit. *In Canada:* J. H. Ryder Machinery Co., Ltd., Toronto 5.

*Trade-Mark Reg. U.S. Pat. Off. and Foreign Countries

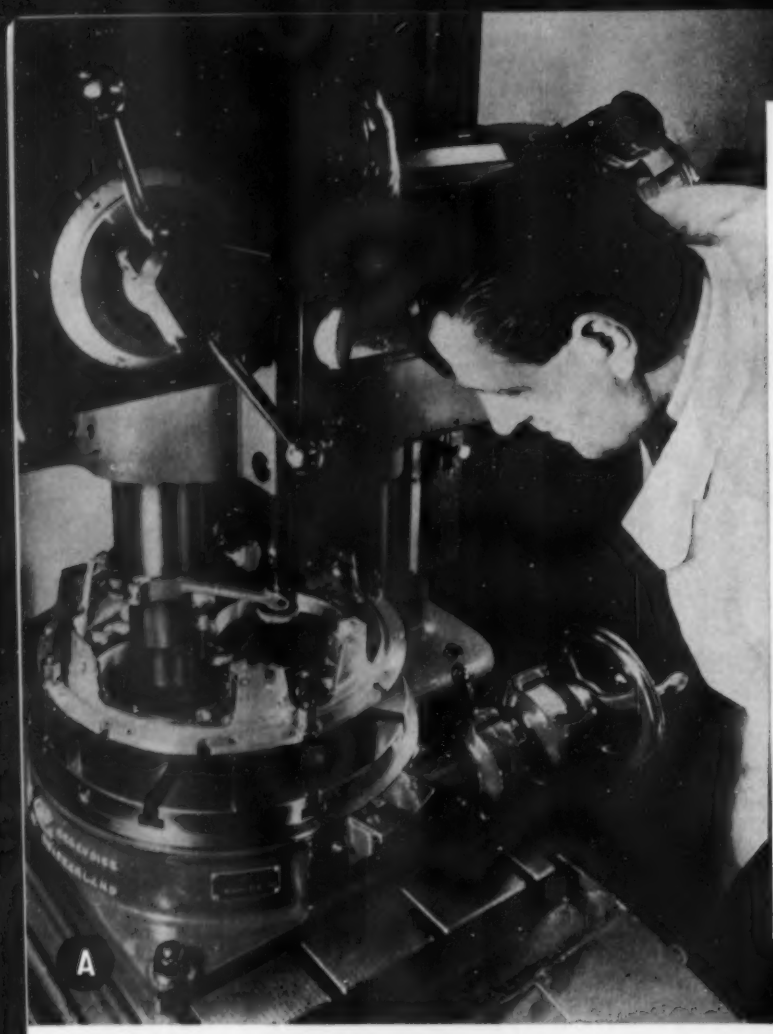


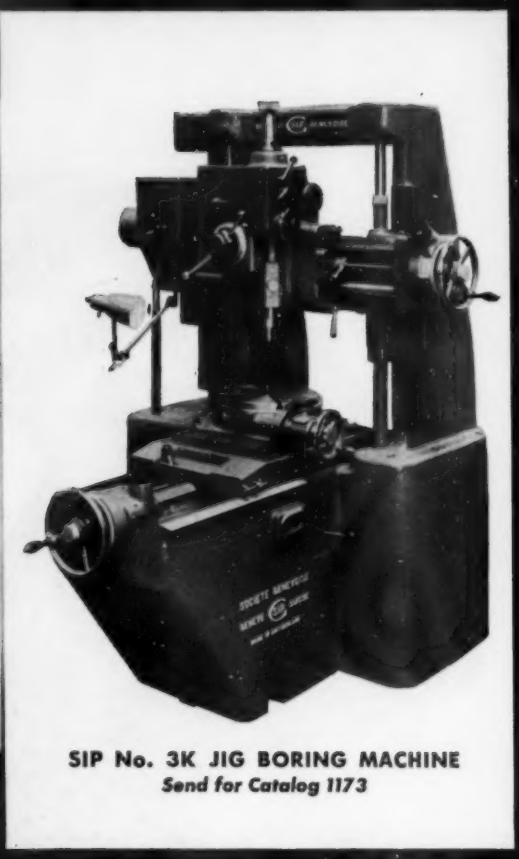
Hollow headstock spindle gives you additional capacity for grinding long bars by passing them clear through and supporting them in grinding position.

Hinged-bracket type internal grinding spindle swings up and out of the way when not in use. This means quicker set-ups for your I.D. or O.D. grinding.

NORTON
GRINDERS and LAPPERS
Making better products
...to make your products better

NORTON PRODUCTS Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals — BEHR-MANNING DIVISION Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

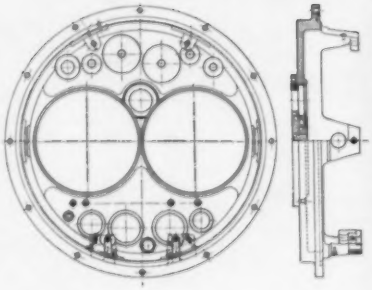


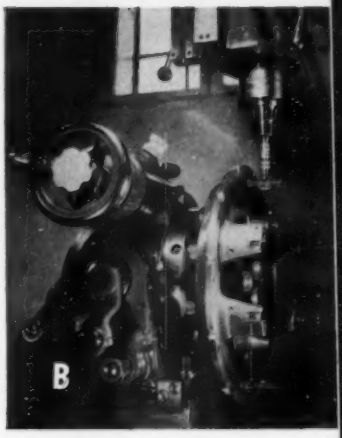


SIP No. 3K JIG BORING MACHINE
Send for Catalog 1173

Illustrated is the machining of a magnesium casting for an electronic unit . . . (A) drilling, boring and counterboring 37 holes, 62 diameters ranging from 0.255″ to 5.125″ . . . (B) drilling, boring and counterboring 11 holes, 16 diameters ranging from 0.100″ to 0.787″. Here's the record:

MACHINING TIME (A).....8 HOURS, 15 MINUTES
MACHINING TIME (B).....2 HOURS, 0 MINUTES





How's that for Production!

The machine that does it is the SIP No. 3K Jig Boring Machine. It has what it takes—ease of operation, increased generous range and capacity, plus the basic Precision that is SIP—to finish critically sensitive jobs like this so fast and so well! SIP quality and precision cost you no more.

and how's this for Accuracy?

HOLE DIAMETERS HELD TO +0.0004″, −0

CENTER DISTANCES HELD TO +0.00025″, −0

SIP *makes Precision Production Practical & Profitable*

AMERICAN SIP CORPORATION

100 EAST 42nd STREET, NEW YORK 17, N. Y.

Since 1926 all SIP Machines delivered to U.S.A. and Canada have been calibrated in the INTERNATIONAL INCH (1″ = 25.4 mm).

SUNNEN HONING

ELIMINATED THE "BUGS" FROM TANDEM BORE FINISHING AT

J&L®

At Jones and Lamson — precision is an important part of the production of every product.

A typical example is furnished by J & L specs. on the main column bearings of the Model PC-14 Optical Comparator. Spaced on 10" centers these two holes (tandem bore) are 3" long x 3½" in dia.
No measurable deviation is permitted from perfect roundness, straightness, and alignment — and after assembly only .0002" difference between spindle and bearing diameters is allowed at equal temperatures, *yet, spindle must slowly slide through bearing of its own weight.*
To meet these specifications, J & L simultaneously hones both holes with Sunnen equipment. A total of .003" of stock being removed by rough and finish honing. Final surface finish is held to 20 microinches for good lubricant retention. *J & L also "Sunnen-hones" many other machine tool parts, both large and small.*

HOW ABOUT YOUR PRODUCTS?

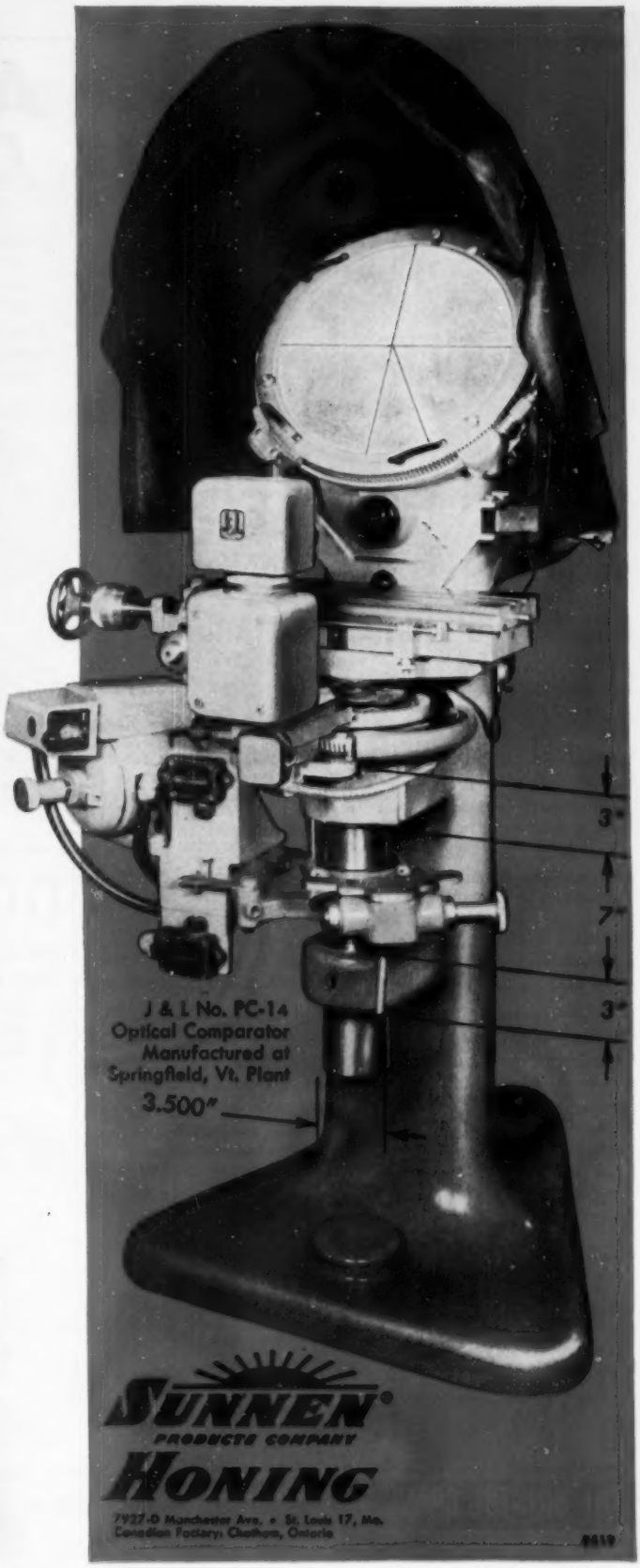
Do they require accurate bore sizing, smooth working fits or tandem hole alignments? If so, investigate the advantages of fast stock removal plus precision that only Sunnen honing equipment can provide. We'll welcome an opportunity to analyze your problems or to demonstrate our equipment on the job without obligating you in any way.
Average installation of Sunnen Honing Machine with tooling, costs only about $1000.

RANGE OF SUNNEN HONING TOOLS

- **For Machine Applications**
  Standard from stock, .100" through 2.625" dia.
  Built to order, through 4½" dia.
- **For Portable Applications**
  from 1¾" through 20½" dia.

YOURS FOR THE ASKING

BULLETIN XSP-5075
99 Case histories with honing production rates



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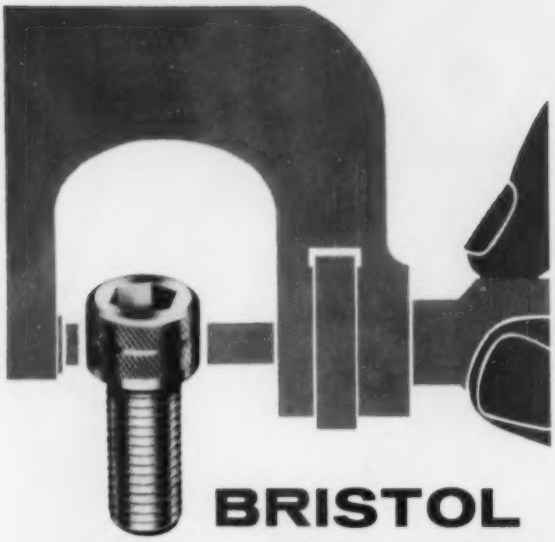


BRISTOL

socket cap screws meet newly established industry standards

Have higher strength, greater holding power than ever

Bristol socket cap screws are now available to meet all the recommendations of the Socket Screw Manufacturers' Committee standards.

These new standards—plus Bristol's stringently applied quality-control—are setting a new high for performance. Check these advantages:

- Great bearing surface under the head because of increased head diameter (1½ times body diameter).
- Less need for washers, less indenting of metal.
- Greater holding power under shock and vibration.
- Larger socket—you can wrench-up screw tighter.
- Greater engagement of head, greater clamping power.

These new Bristol socket screws are just one important example of the way Bristol develops new products to meet the needs of modern manufacturing.

You'll find precision Bristol socket screws—both hex and Bristol Multiple-Spline—in a wide variety of equipment today. They're used by the millions in machinery, machine tools, appliances, instruments, computers, aircraft and missiles (including count-down, tracking, and ground-support equipment), and wherever highest standards of quality and reliability are imposed. A.9.1

Old dimensional standards will continue to be available.

Precision socket screw manufacturers since 1913

*Made in sizes as small as No. 0 in Alloy Steel and Stainless Steel. Cap screws up to 1½" diam.

THE BRISTOL COMPANY Socket Screw Division Waterbury 20, Conn.

USE READER SERVICE CARD; INDICATE A-4-236-1

ACCURACY .0002 T.I.R.

.0002 T.I.R. or less at Spindle Nose, .0005 T.I.R. or less on Test Arbor six inches from Spindle Nose

SPINDLE SPEEDS 150 and 250 RPM Other Spindle Speed Pulleys Available

MODEL B943 MOTOR DRIVEN WORK HEAD

No. 11 B & S Tapered Spindle Standard Equipment. No. 12 B & S or No. 5 Morse Available at Slight Extra Cost.

Clip ad to your letterhead and send for Literature

K. O. Lee Company, Aberdeen, S. D.

USE READER SERVICE CARD; INDICATE A-4-236-2

DONT GAMBLE

USE *Only* CARR-LANE *Tool Proven*"... JIG AND FIXTURE COMPONENTS

● ALL ITEMS PRECISION MADE, HEAT TREATED AND RUST PROOFED

Carr Lane **MANUFACTURING CO.**
4200 KRAUSE COURT
SAINT LOUIS 19, MISSOURI

USE READER SERVICE CARD; INDICATE A-4-236-3

Why the Die Designer Prefers PRODUCTO Die Sets

He can specify Producto with complete confidence

The die designer likes to specify Producto die sets on his blueprints because they are a nationally-accepted "brand." They're easy to get anywhere... and delivery is prompt.

He favors Producto because he knows he never has to compromise his die design. Even if the die layout is a little unusual, he will be able to select a die set to accommodate it from Producto's wide range of thicknesses and styles.

He also knows Producto has the equipment that can cut his tooling costs by letting him adapt his sets to a more economical *basic* design. Only Producto offers him complete foundry, pattern-making, welding and machining services for his special requirements.

The die designer recognizes Producto's Qwik-Fit Guide Pins as an important new feature that die makers want. He specifies them because they save up to 75% of the time normally required for die set assembly and disassembly.

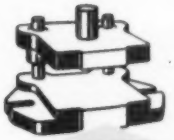
The die designer likes to use Producto's new catalog, the industry's most practical tool. His die layout is simplified when he uses Producto die set templates. And Producto provides him with cost-saving ideas in the DIE SET DIGEST.

Most important, he can depend on *consistent* Producto die set accuracy to transfer from the drawing board to the press the precision and ingenuity of his die design.

Yes, the designer has found that Producto die sets justify his confidence in specifying Producto. You will, too.

TWO FREE AIDS to more economical, efficient use of die sets are available from Producto. All-new CATALOG NO. 11 makes ordering and selection job easy. DIE SET DIGEST gives valuable tips for designers, builders and users of dies. Write for them today.

THE PRODUCTO MACHINE COMPANY
925 Housatonic Ave., Bridgeport 1, Connecticut



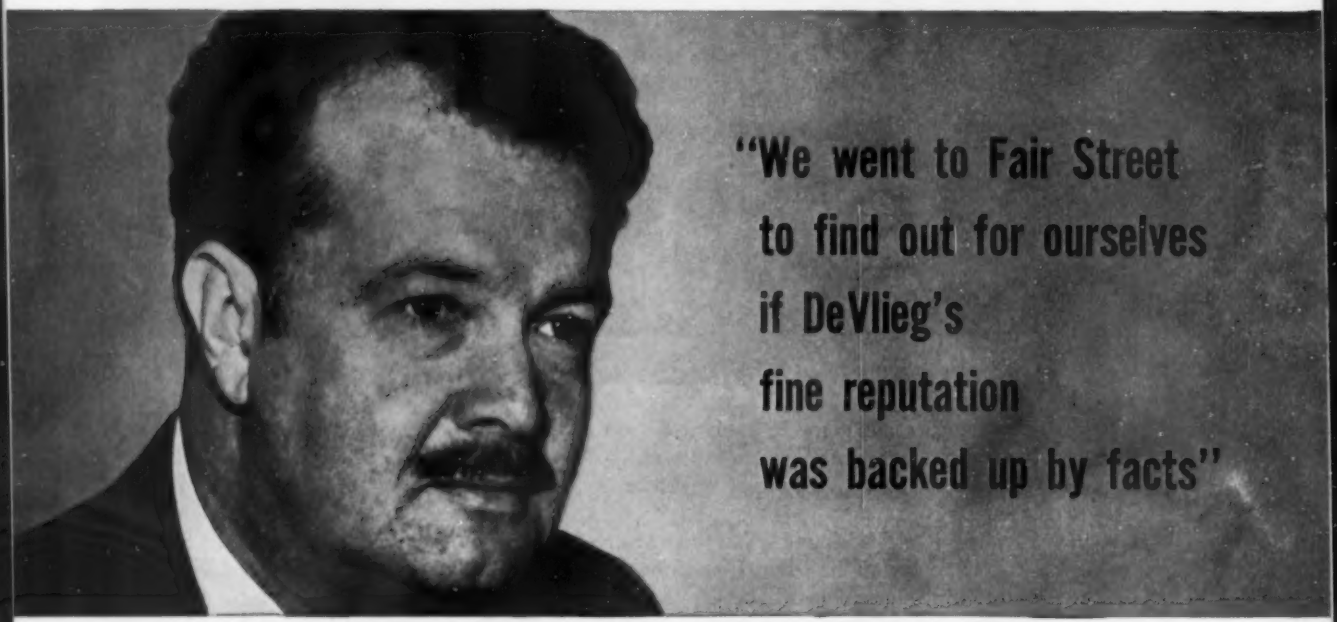
Wherever die sets are used

PRODUCTO

PRODUCE MORE WITH PRODUCTO PRECISION DIE SETS

GUSTAV VON REIS, President
Detroit Broach & Machine Co.

a man who came to Fair Street



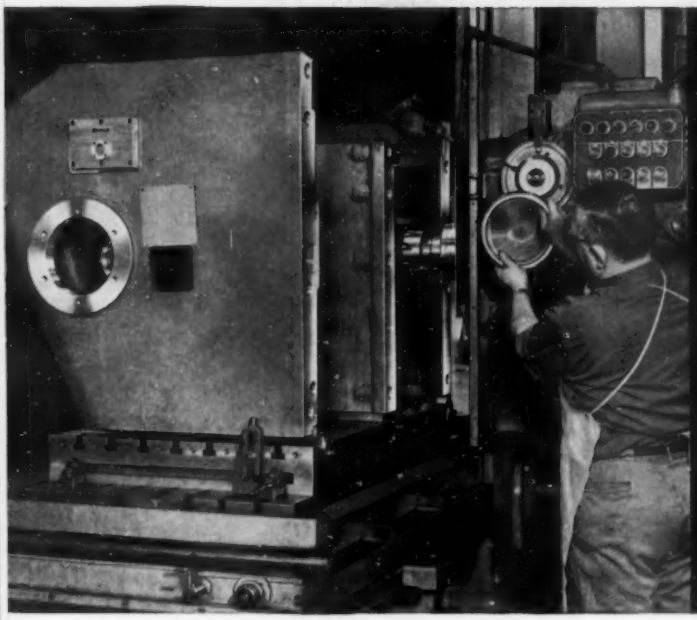
"We were convinced. We purchased two JIGMILS and they have now been in operation for several years. These machines have all the fundamentals required to produce the highest degree of accuracy, and yet, are simple to operate. Besides this, and we feel most important of all, the JIGMIL has special features which largely eliminate our reliance on the human element to produce close tolerance work. JIGMILS enable us to produce our broaching machines and broaching tools to the very highest degree of accuracy, a matter of the utmost importance in our products."

GUSTAV VON REIS

DE VLIEG MACHINE COMPANY, FAIR STREET • **ROYAL OAK, MICHIGAN**

SOME OF OUR JIGMIL USERS

Akramatic Engineering
American Mach. & Tool Co.
Apex Corp.
Barker Tool Die & Gauge Co.
Base Tool & Gage Co.
Bengal Boring Co.
Best Tool & Engineering Co.
B. H. Aircraft Co., Inc.
Black Rock Mfg. Co.
Bradley-Thompson Tool Co.
City Pattern Foundry & Mach. Co.
Compton Boring Co.
Crest Tool Industries, Inc.
Dearborn Tool & Die Co.
Detroit Gauge & Tool Co.
Detroit Jig Grinding Co.
Eglinton Carbide Products, Inc.
Ensign Tool & Gauge Inc.
Evans Tool & Die Co.
Fuller Tool Co.
Glendale Machine & Tool Co.
Hiser Jig Grinding Co.
Jameson Machine Co.
Jones Tool Products
Lamina Dies & Tools, Inc.
Langlois Tool & Die Corp.



A FEW PROVEN ADVANTAGES OF THE JIGMIL TECHNIQUE

- Eliminates cost of expensive jigs and production delays resulting from their manufacture.
- Simplifies tooling.
- Employs automatic functions to reduce factors of human error even in close tolerance work.
- Makes possible greater flexibility of product design.
- Improves end product by permitting interchangeable assembly of parts without hand fitting.
- Increases production and product accuracy.

ACCURACY IS AN ECONOMY!

JIGMIL—EXTREME ACCURACY ON LARGE, WEIGHTY PARTS FOR DETROIT BROACH

Broaching machine knee, 65" long, weight 5500 lbs., set-up on a 32" x 60" index table on a Model 4B-72 JIGMIL. The knee is rough and finish milled, bored, drilled and tapped from four sides in one set-up. Formerly machined on a conventional boring mill, the job took 120 hours. The JIGMIL now completes all machining operations in 50 hours with consistent accuracy and without special tooling. Furthermore, the accuracy achieved effects substantial reductions in assembly time and improves the quality of the end product.

Our newest catalog will help you decide. May we send it?

Maks Machine Co.
Mark Twain Tool & Mfg. Co.
McDonnell Machine Products, Inc.
Modern Industrial Eng. Co.
Mohawk Metal Forming & Tool Corp.
Mt. Clemens Mfg. Co.
Olofsson Tool & Die Co.
A. E. Parker & Sons Co.
Precision Boring Co.
Product Engineering & Mfg. Corp.
Progressive Industries Co.
Schwartz Mach. Co.
Special Machine & Eng., Inc.
Tragge Boring Co., Inc.
Turner Bros., Inc.
Vulcan Eng. Co.
Westfield Tool & Eng. Co.

WILL YOU BE THE NEXT TO VISIT FAIR STREET

DeVlieg

SPIRAMATIC JIGMILS®

ACCURATE HOLES AND FLAT SURFACES IN PRECISE LOCATIONS

NOW—A LOW-COST LAPMASTER

Specifically Designed for Maintenance Lapping

new Lapmaster® MODEL 10

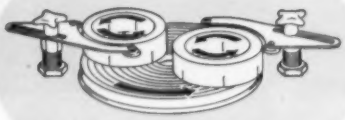
Saves Time and Money On:

VALVE SEATS • MECHANICAL SEALS
COMPRESSOR DISCS • DIESEL INJECTOR
AND OTHER MISCELLANEOUS PARTS

- Faster than old lapping methods.
- *Consistently* laps to flatness within .0000116" and micro-inch finishes of 2 to 3 RMS.
- Operator need not be experienced.
- Handles parts up to 7" diameter to meet all usual maintenance lapping needs.
- Will handle parts of any shape or form . . . any metal, ceramics or plastic.
- Automatically controlled lapping cycle.
- Size: 18" x 13" x 12". Weight: 133 lbs.
- Operates on any 110 volt—60 cycle—single phase outlet.

NO TIME LOST

in Reconditioning Lap Plate with Exclusive LAPMASTER PRINCIPLE



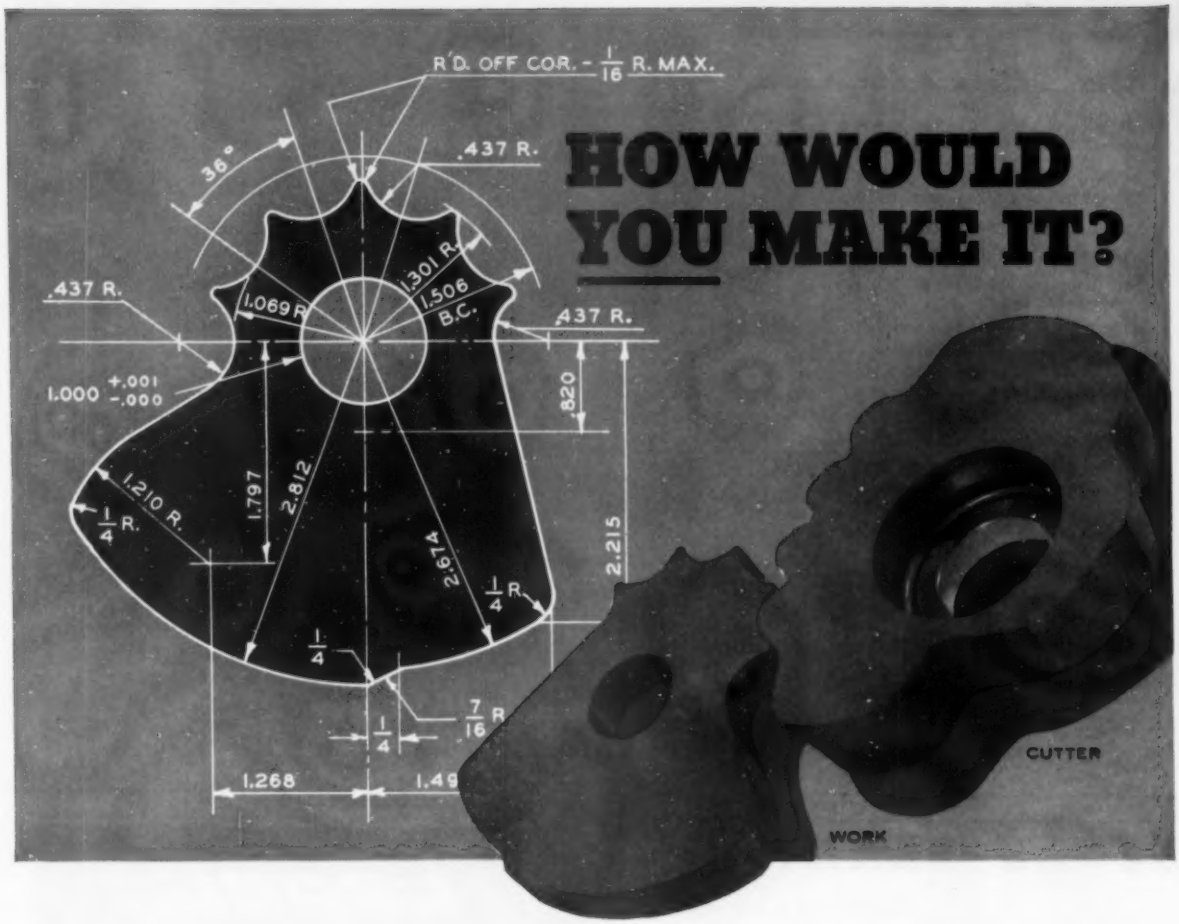
No down time for truing lap plate . . . conditioning rings automatically keep plate flat and true.

Lapmaster® . . . THE MACHINE THAT PUT PRECISION LAPPING ON A PRODUCTION BASIS

WRITE FOR THE COMPLETE LAPMASTER STORY

Write for bulletins describing the Lapmaster line and chart on measuring flatness.

A product of
Crane Packing Company
6469 OAKTON ST. • MORTON GROVE, ILL. (Chicago Suburb)
In Canada: Crane Packing Company, Ltd., Hamilton, Ont.

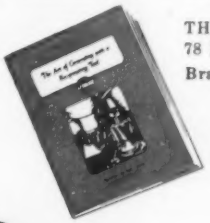


HOW WOULD YOU MAKE IT?

Cams and other non-circular shapes in almost unlimited variety can be generated accurately and at low cost on the Fellows Gear Shaper. In many cases, the easy versatility of the machine permits a single set-up where other methods of production would require a series of costly set-ups and operations.

The cam shown above is an example. It was generated in a single operation, using the cutter (shown at right, above) specially designed and manufactured by Fellows for the job. Set-up was simple, production was fast, accurate and inexpensive.

The same Fellows Gear Shaper, using appropriate cutters, can produce internal and external spur and helical gears, gears close to shoulders or in recesses, tapered gears, face gears and clutches. The advantages of the Gear Shaper are described and illustrated in "The Art of Generating with a Reciprocating Tool." This booklet, although not new, contains a wealth of information valuable to designers. We have distributed over 10,000 copies since 1951. If you would like one, just write us.



THE FELLOWS GEAR SHAPER COMPANY
78 River Street, Springfield, Vermont

Branch Offices:
1048 North Woodward Ave., Royal Oak, Mich.
150 West Pleasant Ave., Maywood, N. J.
5835 West North Avenue, Chicago 39
6214 West Manchester Ave., Los Angeles 45

THE PRECISION LINE

Fellows *Gear Production Equipment*

1000 strokes a minute!

Now in daily operation at the Truarc Retaining Rings Division of Waldes-Kohinoor, Inc., of Long Island City, New York, this new Bliss High Production Press is running at the blurring speed of 1000 strokes a minute, hour after hour, day after day. First of its kind, this completely new press has a revolutionary counterbalancing system and massive, close tolerance construction that virtually eliminate vibration, even at this phenomenal speed. Could a press like this cut your parts cost...add to your profit picture? We'll be glad to give you the facts.

BLISS
SINCE 1857

E. W. BLISS COMPANY · Canton, Ohio

BLISS is more than a name—it's a guarantee

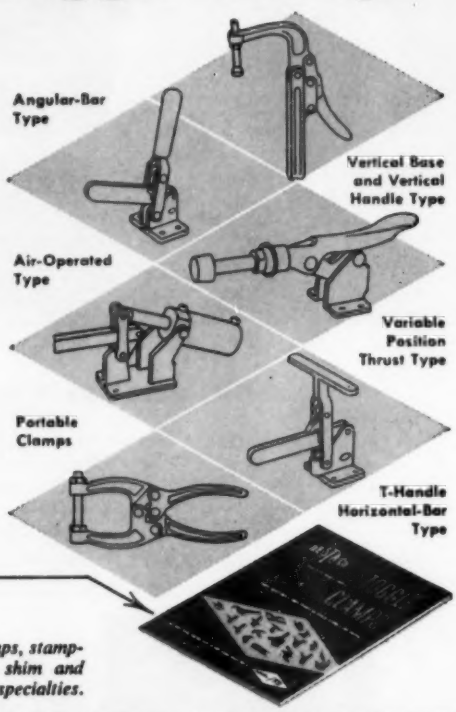
PRESSES • ROLLING MILLS • ROLLS • DIE SETS • CAN MACHINERY • CONTRACT MFG.

Where It's Quality, Quality, Quality!
It's Quality DE-STA-CO Toggle Clamps

FINAL INSPECTION OF ROSS OPERATING VALVES subjects every valve to a pressure test far exceeding its normal usage. For over fifteen years, fixtures similar to this, all employing De-Sta-Co No. 620 plunger clamps, have been built to do this critical high pressure sealing job.

Whether your holding and clamping operation is inspection, machining, tapping, grinding, welding, bonding or other assembly, there is a specific De-Sta-Co Toggle Clamp to do it better. Fast action, positive clamping, long life through thousands of production operations have made De-Sta-Co known for almost 30 years as the leading tool in the field. And all of our medium and larger models use hardened serrated pins in hardened bushings staked to prevent wear. A broad selection of spindle accessories increases the versatility of the clamp you specify.

Our representative in your area is qualified and ready to serve you. Send for our catalog showing clamp applications, scale drawings and complete information.



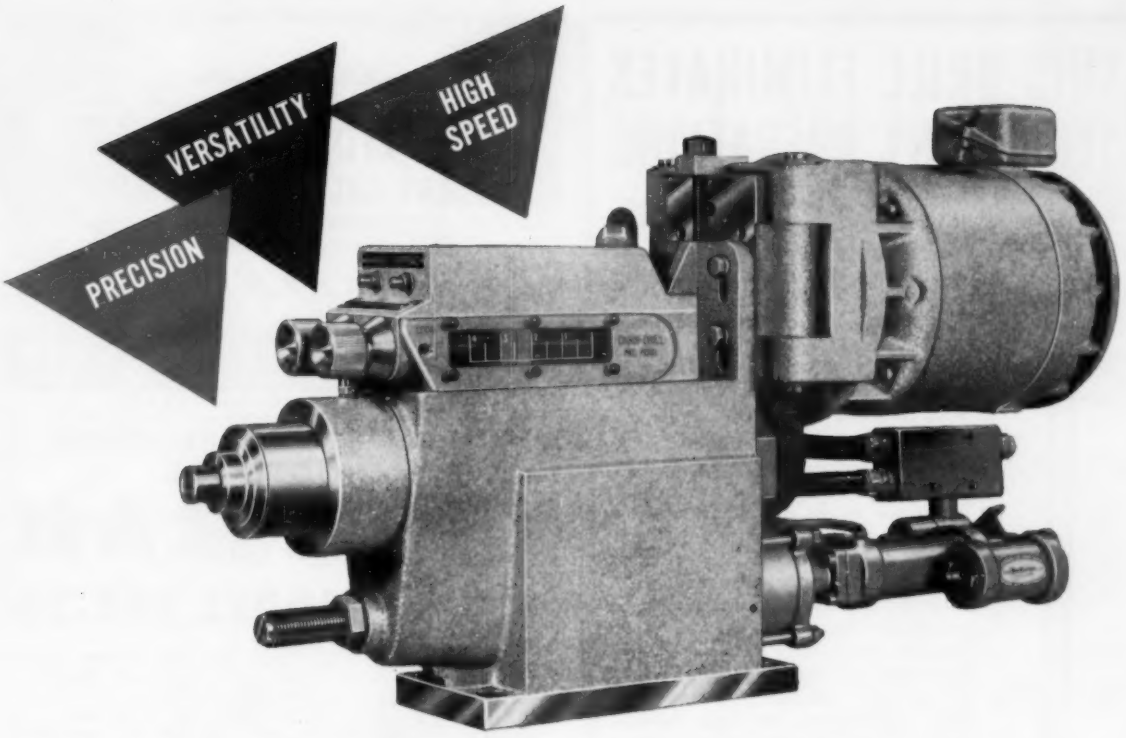
DE-STA-CO

ORIGINATORS OF PRODUCTION CLAMPING

De-Sta-Co is widely known for toggle clamps, stampings, precision washers, spacers, shims, shim and feeler stock, blower housings and marine specialties.

DETROIT STAMPING COMPANY

328 MIDLAND AVENUE • DETROIT 3, MICHIGAN



are a few of the outstanding features of the

BELLOWS "Carbi-Drill" DRILL UNIT

- Capacity up to ⅝" diameter drill in mild steel.
- Runout will not exceed .001" T.I.R. in full 4" stroke.
- Depth accuracy .003" with standard limit switch; .001" with optional Bellows BT-1 Timed Dwell Control.
- Stroke adjustable from 1½" to 4", with optional stops to permit shorter stroke lengths. Thrust is equal to 10 times applied air pressure.
- Spindle speeds available from 609 RPM to 6275 RPM.

This rugged, heavy-duty drill unit is ideal for tool-room built special purpose machinery for drilling, tapping, reaming, counterboring, etc. It can be mounted in any position. Units can be easily synchronized electrically with each other or with other Bellows "Controlled-Air-Power" devices for fully automatic operation. Air-powered rapid advance, controlled hydraulic feed rate, air-powered rapid retract provide maximum speed with feed rate adjustable for any tool working in any material.

Take a quick rundown of the main features of this versatile "CARBI-DRILL" unit, then write for a copy of Bulletin CD-17, which gives complete details. Address Dept. TE 459, The Bellows Co., Akron 9, Ohio. In Canada, Bellows Pneumatic Devices of Canada, Ltd., Toronto 18.

1325-B

The Bellows Co.

DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

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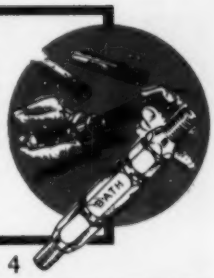
BATH *Tap'n Gage* TIMES

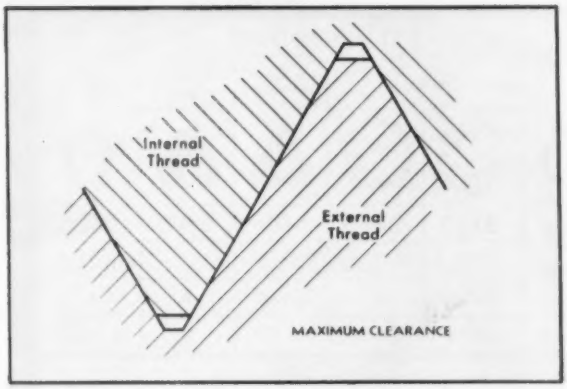


A series of technical discussions that will be helpful in getting better results from tapping and gaging operations

Vol. 1 No. 4

Subject: Pipe Threads and their Applications:

American Standard Taper and Straight Pipe Threads: NPT (National Pipe Taper) and NPS (National Pipe Straight).



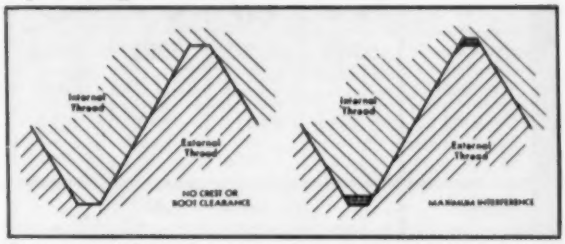
This thread form covers taper pipe threads and various classes of straight pipe threads. Where the fluid or gas pressure is moderate and vibration is no problem, a leak proof pipe thread joint can be made with both external and internal threads tapered; provided that a sealing compound is applied to the thread before assembly. The minimum and maximum limits on truncation and width of flat are the same for both crest and root of both mating threads. The sealing compound fills the clearances between the flats of the external and internal threads to prevent spiral leakage.

For low-pressure commercial products where vibration is negligible, pipe couplings with straight threads (Symbol NPSC) can be assembled with external taper pipe threads (Symbol NPT). A sealing compound is required in this assembly.

Where the threaded joint does not need to be pressure tight or for use in place of a screw thread because of association with pipe threads, free fitting mechanical joints (Symbol NPSM) can be made with straight external and straight internal pipe threads.

For a loose-fitting mechanical joint such as nipple and lock nut assemblies in tanks, the straight pipe lock nut threads (Symbol NPSL) are used. This thread allows the lock nut to be assembled freely to the largest thread it is possible to form on the outside of a standard pipe.

American Standard Dryseal Pipe Threads: NPTF (National Pipe Taper Fuel) and NPSF (National Pipe Straight Fuel).



This thread form covers taper external threads and both taper and straight internal threads. When a sealing compound causes contamination, where the liquid or gas attacks and destroys the sealer, or whenever for any reason a leak proof joint is wanted without use of a sealing compound, the American Dryseal Pipe threads can be used. They have the same basic dimensions as NPT and NPS threads except that the crest flats are of either equal or less width than the root flats. The crest of thread in either complete contact with the root, or crushing into the root, makes the joint pressure tight.

Limits on Crest and Root Flats		
Thds. per In.	Crest	Root
27	.002-.004	.004-.006
18	.003-.005	.005-.007
14	.003-.005	.005-.007
11½	.004-.006	.006-.009
8	.006-.008	.008-.011

Assemblies in which both components have Dryseal Taper Pipe Thread NPTF are generally considered superior for strength and seal to all other pipe forms. Because of this and the ease of production, they have proven successful in many applications where the Dryseal form is not a necessity and where sealing compound is also used. When vibration is present, the Dryseal tapered internal and external threads (NPTF) should be used.

Assemblies of straight Dryseal internal threads (NPSF) with Taper Dryseal external threads (NPTF) are advantageous where economy and rapid production are paramount conditions. They are particularly satisfactory for use when the internal threads are of sufficiently soft or ductile materials to adjust themselves to the taper external threads when properly screwed together.

Aeronautical Taper Pipe Threads: ANPT (Army-Navy Aeronautical Pipe Taper Thread).

Aeronautical Pipe Threads have the same thread form and dimensions as the American Standard Pipe (NPT) except for the 2½" and 3" sizes. All ANPT thread elements are gaged for closer dimensional control. *Additional Pipe Thread Standards having special applications: NPSH-American National Straight Pipe Threads for Hose Couplings and Nozzles; NPSI-Intermediate Straight Pipe Fuel; PTF-SAE Short Taper Pipe Fuel.*

References: U.S. Dept. of Commerce, National Bureau of Standards Handbook H28; 1956 SAE Handbook and MIL-P-7105.

Truarc Retaining Rings, the engineered fastening method for reducing material, machining and assembly costs

function		for axial assembly				for taking up end-play					
						axial assembly				radial assembly	
nomenclature		basic		inverted		bowed		beveled		prong-lock®	bowed e-ring
											
series no.		5000	5100	5008	5108	5001	5101	5002	5102	5139	5131
application		Internal for Housing Bores	External for Shafts	Internal for Housing Bores	External for Shafts	Internal for Housing Bores	External for Shafts	Internal for Housing Bores	External for Shafts	External for Shafts	External for Shafts
range	in.	.250-10.0	.125-10.0	.750-4.0	.500-4.0	.250-1.456	.188-1.438	1.0-10.0	1.0-10.0	.094-.438	.110-1.375
	mm.	6.4-253.8	3.2-253.8	19.0-101.5	12.7-101.5	6.4-37.0	4.8-36.5	25.4-253.8	25.4-253.8	2.4-11.1	2.8-35.0

function		for radial assembly				self-locking types					
nomenclature		crescent®	e-ring	reinforced e-ring	interlocking	circular self-locking			triangular self-locking	triangular nut	grip-ring
											
series no.		5103	5133	5144	5107	5005	5115	5105	5305	5300	5555
application		External for Shafts	External for Shafts	External for Shafts	External for Shafts	Internal for Housing Bores	External for Shafts	External for Shafts	External for Shafts	With Threaded Screw	External for Shafts
range	in.	.125-2.0	.040-1.375	.094-.438	.469-3.375	.312-2.0	.094-1.0	.094-1.0	.062-.437	•	.077-.755
	mm.	3.2-51.0	1.0-35.0	2.4-11.1	11.9-85.7	7.9-50.8	2.4-25.4	2.4-25.4	1.55-11.1	•	•

GENERAL DESIGN PRINCIPLE: Tapered construction permits rings to maintain constant circularity and groove pressure.

Series 5000 and 5100: Basic types for axial installation. Rings provide optimum groove strength.

Series 5008 and 5108: Best clearances. Accommodate parts having large corner radii or chamfers.

Series 5103: Best clearances. Secure against moderate impact, vibration.

Series 5133: Provides high coupling shoulders; accommodates wide groove tolerances. Easy servicing.

Series 5144: Reinforced E-ring. Five times more gripping strength, 50% higher RPM limits than standard E-rings.

Series 5107: High impact resistance; high coupling shoulders. Accommodates extremely high rotation and relative parts rotation.

Series 5001 and 5101: Resilient end-play take-up. Accommodate wide tolerances. Recommended for pre-loading bearings.

Series 5002 and 5102: Rigidly locked end-play take-up. Recommended for locking one race of parallel bearing assemblies.

Series 5139: Rigidly locked into position by protruding locking tabs. Provides high resilient end-play take-up with sliding tabs for uniform flexure. Cannot be forced from groove without destroying ring. Accommodates relative parts rotation. Equally effective with round, square, rectangular or hex shafts.

Series 5131: Provides high take-up. Recommended where clearances are a major problem.

Series 5005, 5115, 5105 and 5305: Prongs dig into shaft, locking rings against movement in one direction.

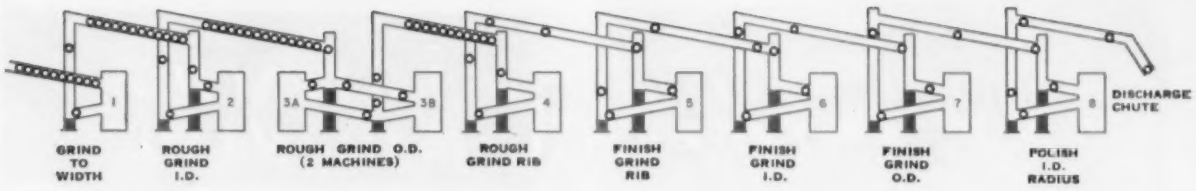
Series 5300: Spring tension locks parts assembled with threaded screws.

Series 5555: Self-locking against movement in either direction by spring tension. Since no groove is required, ring is adjustable to any position on shaft.

Waldes Truarc Retaining Rings are modern fasteners that solve a wide variety of design and production problems. Send for your new 24-page Catalog RR 10-58. 9.4

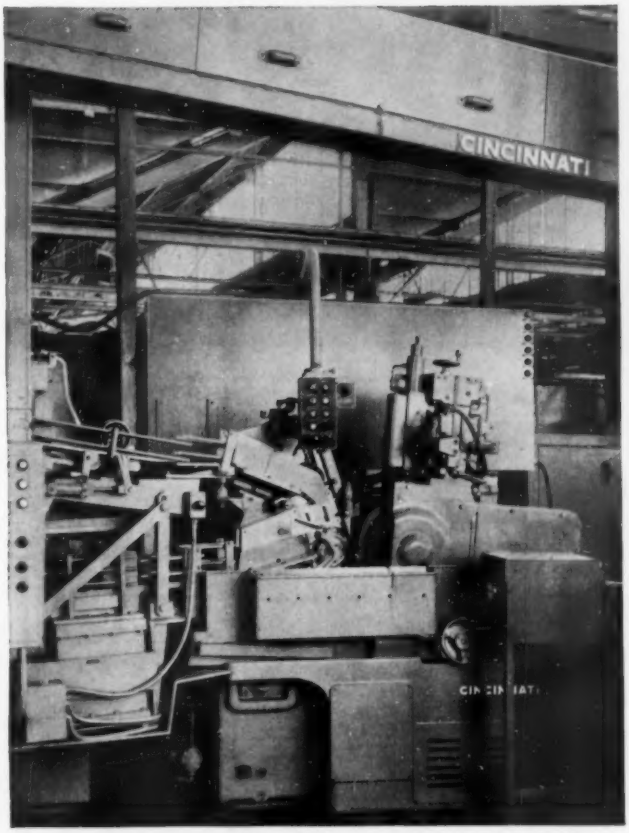
WALDES
TRUARC®
RETAINING RINGS

Waldes Kohinoor Inc., Long Island City 1, N. Y.



CINCINNATI Builds Precision Grinding Lines

. . . to keep your costs in line



MICRO-CENTRIC, one of the fine CINCINNATI FILMATIC Grinding Machines incorporated in the 8-station CINCINNATI Precision Grinding Line diagramed at the top. FILMATIC grinding wheel spindle bearings are an important feature-advantage of this machine. They will never stop the production line.

FILMATIC

Anti-friction bearing cone, a high-quality, high-volume component produced at rock-bottom cost on the CINCINNATI engineered and built Precision Grinding Line described here.

Every shop faces the problem of cost control. It's one of the prime reasons for installing production lines to automatically perform different operations, or a series of **similar** operations like the Cincinnati Precision Grinding Line diagramed above. This equipment produces higher quality bearing cones at a lower cost than ever before. The line is an independent unit system, developed by Cincinnati automation specialists. Each unit constitutes an individual and complete machine, which can be replaced whenever conditions change. Although there are machines of other makes in this line, Cincinnati takes complete responsibility for everything: the machines, tooling, conveyors, electrical equipment, quality and production.

Parts rolling off this line conform to the highest standards of precision bearing manufacture. In all, there are seven grinding operations and one polishing operation. Grinding stations incorporate Cincinnati Automatic Sizing with feedback controls and automatic washing and demagnetizing of the parts. A banking arrangement for the first three machines takes care of unforeseen difficulties. The automatic handling equipment accommodates five sizes of bearing cones covering a diameter range of 2 to 1. It requires no adjustment whatever in changing from one size to another.

Cincinnati's forward-thinking engineering staff and extensive manufacturing facilities are tops for developing and building production lines of this type. We invite your inquiries on precision cylindrical grinding equipment of any size ranging from versatile toolroom grinders to completely automatic precision grinding lines.

GRINDING MACHINE DIVISION
The Cincinnati Milling Machine Co.
Cincinnati 9, Ohio

CINCINNATI

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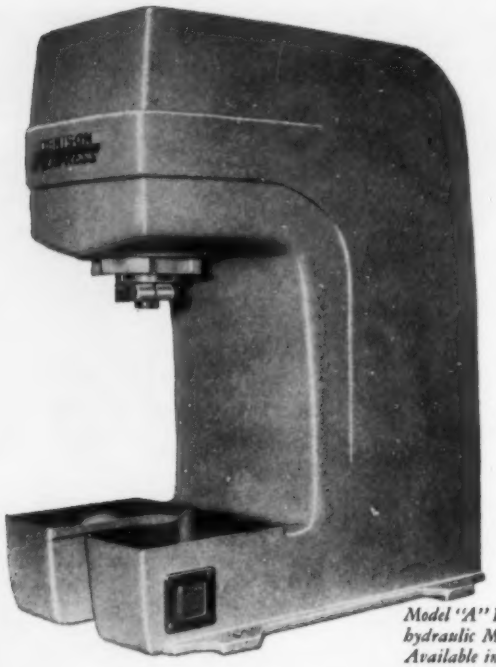

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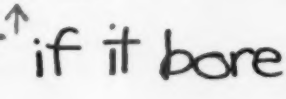
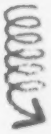
DENISON HydrOILics

HYDRAULIC PRESSES • PUMPS
MOTORS • CONTROLS

If it rolls on an axle  or turns in a bearing  or rides on a shaft  if it slides in a groove or moves on a pivot  if it bores  or cuts  or transmits pressure  one of Sinclair's 500 specialized lubricants is designed to make it work better. For answers to your lubrication problems, write today to

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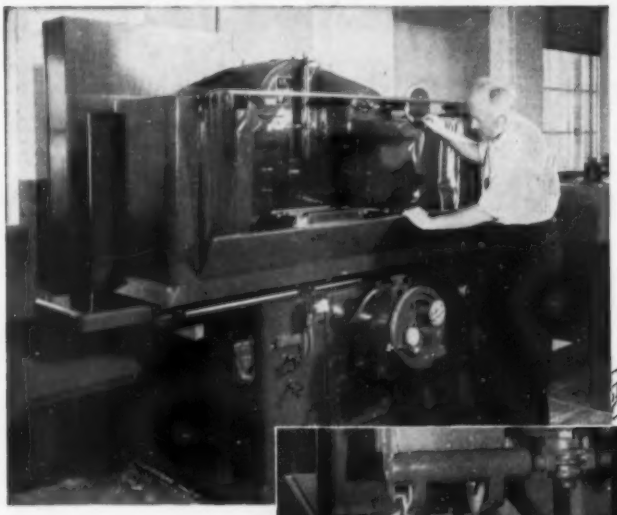

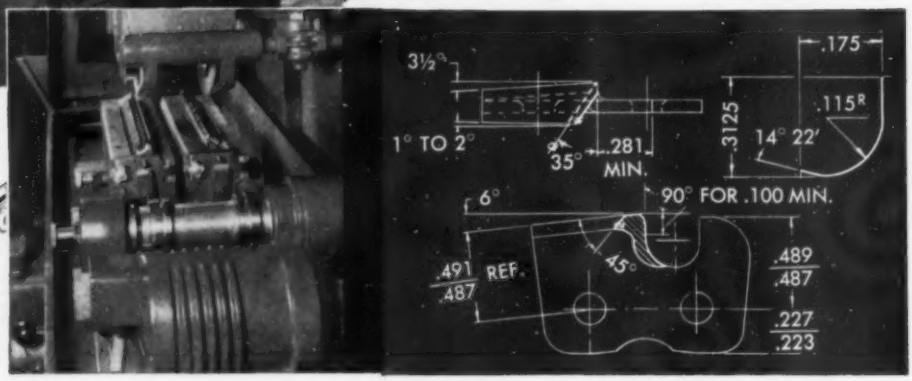

For 140 years, the policy of The Draper Corporation of Hopedale, Mass., has been to offer the highest quality product at the least possible cost.

Following this policy, its subsidiary, BlueJet Corporation, manufacturers of the famous BlueJet saw chain, installed a Thompson Truforming grinder to grind the cutting edges on their chain saw routers. These routers were formerly ground, piece by piece, by a force of 8 employees.

The Thompson Truforming operation is now cutting former grinding costs by 60%. 3 men only are now required for the operation. 40 L.H. and 40 R.H. routers are now ground simultaneously with one pass of the crush formed wheel, resulting in a day's production of over 12,000 pieces—many times that produced by the former method. Both the uniformity and sharpness of the routers have been greatly improved.

For 25 years, Thompson has pioneered and developed the modern advances in crush form grinding. If you have a time-saving, product-improving or cost-cutting problem in your operations, it will pay you to investigate the work Thompson Truforming grinders are now doing in plants all over the country. Our engineering experience is available to you without obligation. Write for Catalog T558.

"Keep Thompson in mind for the daily grind"

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SPRINGFIELD, OHIO

SURFACE GRINDERS

The pitman connection of the new Oliver-Farquhar O. B. I. Mechanical Gap Press provides two basic advantages... easy slide and die adjustment and extra strength.

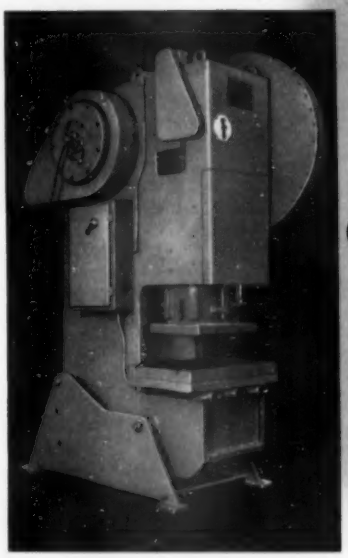
This Oliver-Farquhar Press has

STRENGTH

where you need it...

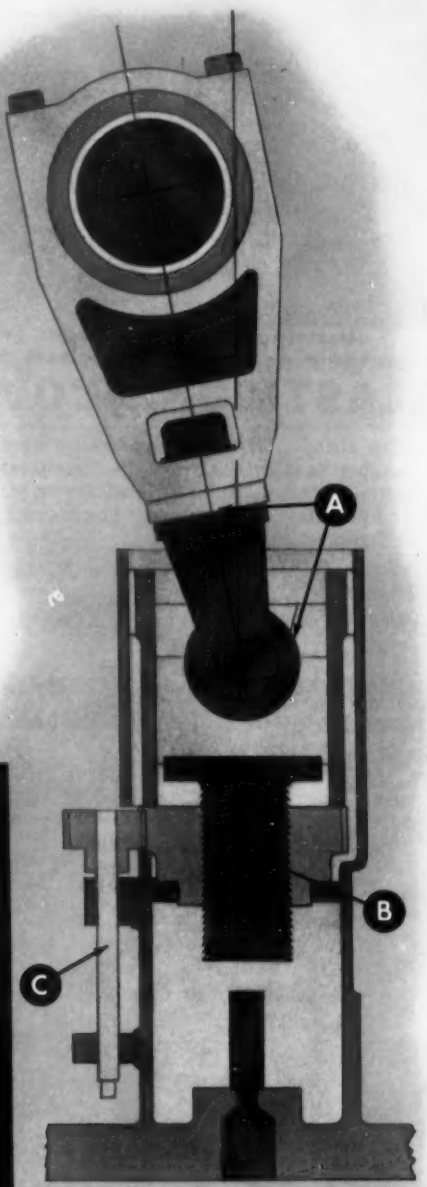
Easy slide adjustment

where you want it...



The Oliver-Farquhar O. B. I. Mechanical Gap Press has a heavy-duty barrel type pitman connection with the slide adjusting screw fully guided to eliminate side thrust and bending loads on the screw. It withstands the full loads of the press at each stroke and the shocks developed in pressing and stripping. There is no danger of bent screws and cracked or broken pitmans. For faster, easier floor level slide adjustment, a simple, directly connected shaft extends to lower end of slide. No special wrench is required for this manual adjustment.

Oliver-Farquhar O. B. I. Mechanical Gap Presses have many features—in addition to the strong pitman connection—that guarantee years of dependable, efficient service. They are available now for delivery in four standard models: 75, 110, 150 and 200-ton capacities.



Oliver-Farquhar design . . . (A) Critical areas are thoroughly supported for maximum strength. (B) Fully guided adjusting screw is held firmly in base. (C) Easy, floor-level adjustment.

Write, wire or phone for complete details or ask for our recommendation.

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Farquhar PRESSES

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UNIPUNCH PRESS

10 Ton Hydraulic LOW-PRICED

This ALL NEW 10 TON UNIPUNCH PRESS with UNIPUNCH TOOLING punches holes in sheets, angles, channels and extrusions plus notching operations . . . more economically and more efficiently.

UNIVERSAL USE—may also be used for small stampings.

Only UNIPUNCH PRESS has ALL these features:

- Simplicity of design (air-hydraulic)
- Minimum of moving parts
- Operates at 10 tons from 80 lb. air pressure
- 1⅞" ram adjustment
- ½" adjustable power stroke
- Foot operated control
- No double stroking
- 13½" throat depth without gauging
- Gauging from center of ram to the left 24" and front to back 12" (punches to center of 24" sheet)
- Gauging equipped with 7 adjustable stops—additional stops available and attached in seconds
- Optional gauging over 24" available.

STANDARD PACKAGE OF UNIPUNCH TOOLING

3 standard UNIPUNCH Hole Punching Units including:
38 standard punches for .093" to 2.000" diameter round holes.
76 standard die buttons for 20 gauge to ¼" thick mild steel.
1 UNIPUNCH Hole Punching Unit (for up to ¾" mild steel) including:
5 standard punches for .250" to .500" diameter round holes.
10 standard die buttons for 5/16" to ¾" thick mild steel.
(Shaped punches and die buttons for above also available)
1 5 x 5 UNIPUNCH 90° Notching Unit:
For notching up to 5" x 5" in 20 gauge mild steel.
For notching up to 3" x 3" in 1/16" thick mild steel.
For notching up to 1¾" x 1¾" in ¼" thick mild steel.
1 combination stand, cabinet with drawer and shelf for convenient storage of UNIPUNCH TOOLING and 1 adjustable work light.

UNIPUNCH PRESS and UNIPUNCH TOOLING are an unbeatable combination for *cutting* costs.

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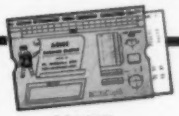
Acme's concerted effort to supply your needs has built a strong national distribution system. All standard bushings and dowel pins are stocked by your local distributor. Try his service. We believe it's unbeatable.



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NOW YOU CAN GRIND AND FINISH

NEW BAYFLEX DOUBLE-DUTY

Illustrations above show Bayflex Double-Duty in action, held at correct angle for weld bead grinding (top) and for finishing (bottom)

WITHOUT CHANGING WHEELS!

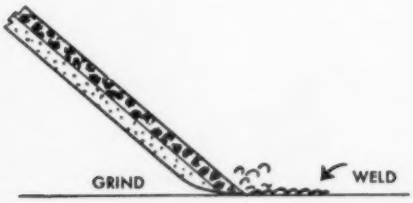
IS 2 WHEELS IN 1

There are two important angles to consider before you buy new weld-grinding or finishing wheels. Bay State's new Bayflex Double-Duty raised hub disc-wheel has them *both!*

The "DD's" unique, two-layer construction gives you two grinding angles: One is 30° - 45° which gives you fast stock removal for grinding weld beads . . . and the other is 10° - 20° which gives you a finish without gouging, a finish so smooth it's just short of a polished surface.

The upper layer for weld grinding comes in a single, standard specification. The lower finishing or blending layer comes in your choice of five different grits (24, 36, 54, 80 and 120) for every type of finishing job from heavy steels through light stainless sheets to aluminum and copper.

Your Bay State representative is ready now to demonstrate the Bayflex Double-Duty in your plant under normal working conditions. Get in touch with him and see what he can do to cut costs and speed up your weld grinding. You'll find he's more than a good salesman . . . because he's an experienced abrasive specialist, too. *Better grinding at lower cost . . . that is his business.*



Upper layer removes stock rapidly when disc is held at 30° - 45° angle.

Lower layer smooths and blends surface when held at 10° - 20° angle.

BAY STATE ABRASIVES

BAY STATE WHEELS of PROGRESS

Bay State Abrasive Products Co., Westboro, Mass.
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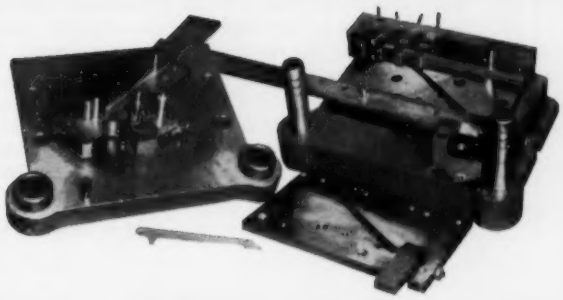
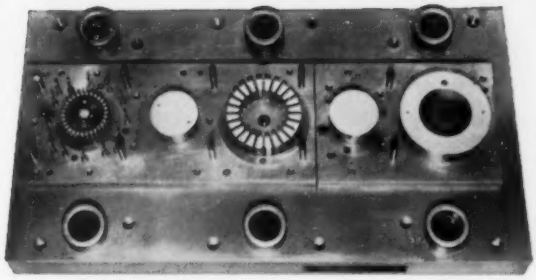
Distributors: All principal cities

the names that stand for **production**

in the metal-working centers of America

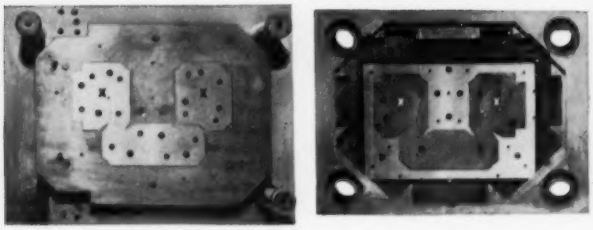
air hard





ohio die

crocar



These are the most profitable cold work die steels at the disposal of the diemaker today, in down-to-earth *performance per dollar per pound.* Each is an air-hardening grade, each has its unbeatable area of application. Only three names to remember —AIR HARD, OHIO DIE, CROCAR— and you've got it made! *Check us for the technical data you can use.*

VANADIUM-ALLOYS STEEL COMPANY

LATROBE, PENNSYLVANIA

DIVISIONS: Anchor Drawn Steel Co. • Colonial Steel Co. • Metal Forming Corporation • Pittsburgh Tool Steel Wire Co.

SUBSIDIARIES: Vanadium-Alloys Steel Canada Limited • Vanadium-Alloys Steel Societa Italiana Per Azioni • EUROPEAN ASSOCIATES: Societe Commentryenne Des Aciers Fins Vanadium-Alloys (France) • Nazionale Cogne Societa Italiana (Italy)

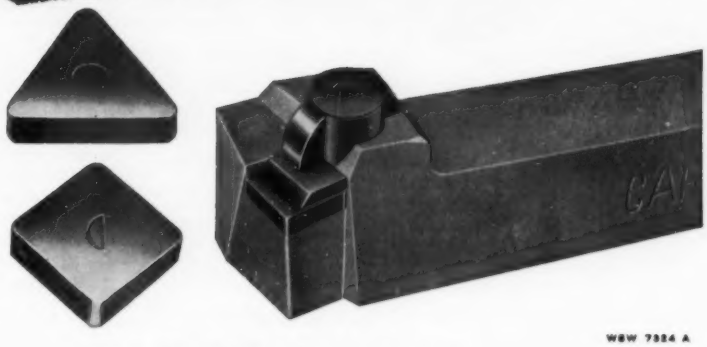
Just as a matter of machining economy—
Why don't you investigate

CARMET INDEXABLE INSERTS
AND TOOLHOLDERS

Cost to regrind single point tool	*50¢ to 1.50*
Cost to regrind Carmet Indexable Inserts	*NOTHING*
Cost of 800 brazed single point tools at approx. $3.50	*$2,800.00*
Cost of 100 square Carmet Indexable Inserts with 800 cutting edges, approx.	*$100.00*

Plus **savings in higher production, longer tool life, tool storage, tool inventory, less tool-change downtime**

Over 9 styles and 109 sizes in Carmet cadmium plated tool holders. 6 carbide grades for machining almost all material from wood and plastics to high alloy steels.



WBW 7884 A

Write for new Catalog C-16

CARMET CEMENTED CARBIDES FOR INDUSTRY

This 32-page first edition contains prices and complete specifications on Carmet's full line of cemented carbide tipped tools, blanks and holders. Speed and feed charts, grade comparisons and ordering information included.

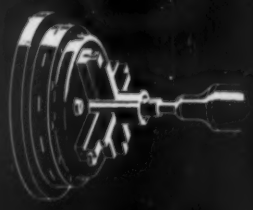
ADDRESS DEPT. TE-161

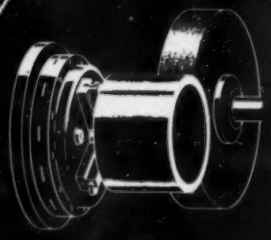
See your Carmet Distributor now or write
Carmet Division, Allegheny Ludlum, Detroit 20, Michigan

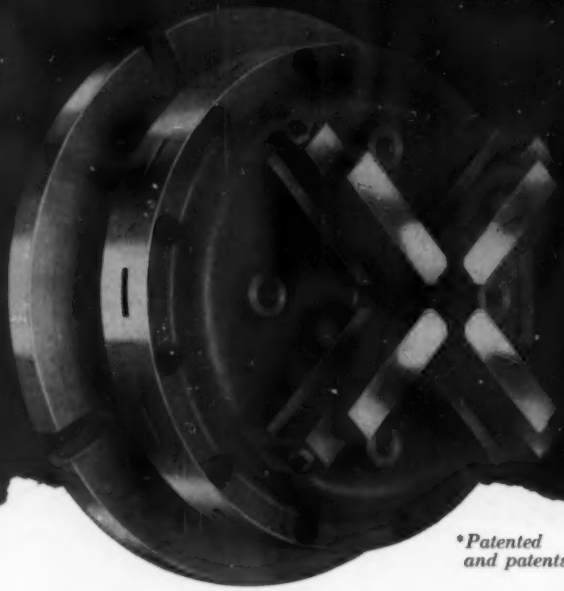
CARMET

CEMENTED CARBIDE DIVISION OF
ALLEGHENY LUDLUM STEEL CORPORATION

New ERICKSON
Air Operated or Manual
DIAPHRAGM CHUCKS
for utmost accuracy and concentricity







- *greater jaw rigidity*
- *internal or external chucking*
- *easy diaphragm replacement*
- *eliminates air leakage*

**Patented and patents pending.*

Basic design of new Erickson Air Operated Diaphragm Chucks* offers distinct advantages in three important areas:

Higher Production Speeds. Reduction in weight over conventional designs means lower inertial forces. Reduction in overhang reduces centrifugal forces; cleats provide sufficient counterbalance. Conventional compression-type adjustment for locating jaws gives greater jaw bearing and maximum rigidity for highest speeds.

Precision Performance. Traditional Erickson precision design and construction for utmost accuracy and concentricity.

Lower Maintenance. Diaphragm construction, with hold-down screws located on flat outer edge of diaphragm, reduces stress concentration and eliminates need for clearance holes through diaphragm for mounting bolts. Design gives higher yield point for diaphragm longevity and easier replacement. O-ring seals eliminate air leakage. Sludge slots around periphery promote escape of grinding dust and other maintenance-causing particles. AA-9606

Write for your free copy of "Erickson Air Operated Diaphragm Chuck" today.

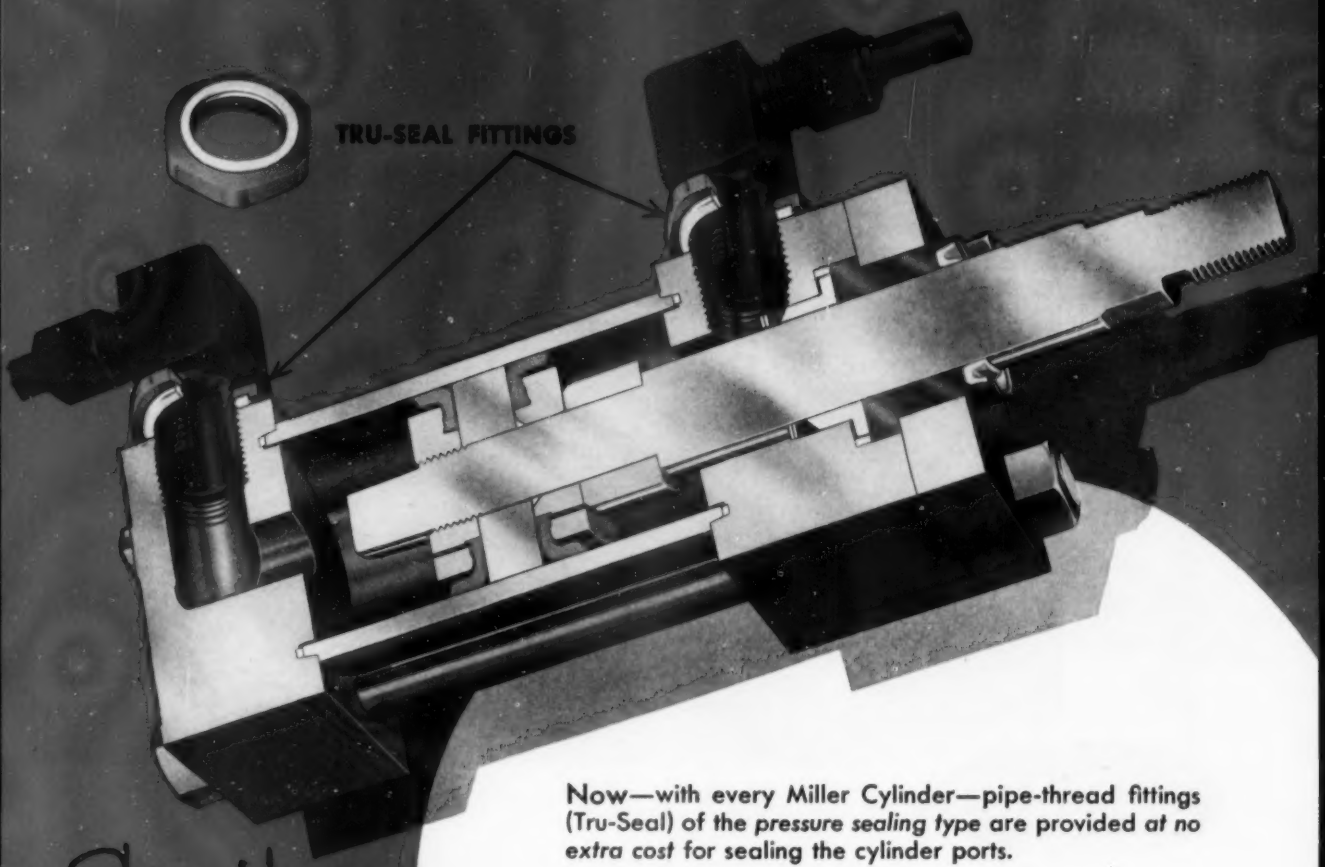
ERICKSON TOOL COMPANY

34453-4 SOLON ROAD • SOLON, OHIO

COLLET CHUCKS • EXPANDING MANDRELS • AIR-OPERATED CHUCKS • FLOATING HOLDERS • TAP CHUCKS
AUTOMATIC INDEXING • MASTER SPACERS • DIAPHRAGM CHUCKS • PUSH-ON ARBORS • QUICK-CHANGE HOLDERS
EXPANDING COLLETS • END-CLAMPING CHUCKS • AIR CYLINDERS (allowing stock to pass through)
EXPANDING JAW MANDRELS • SPECIAL HOLDING FIXTURES

NOW... even the PORTS have seals of the PRESSURE SEALING TYPE!

(J.I.C. Standard H6.2.2)

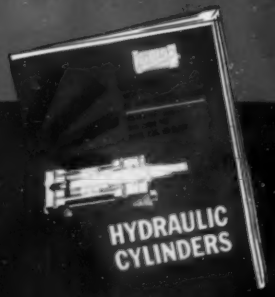


Now—with every Miller Cylinder—pipe-thread fittings (Tru-Seal) of the *pressure sealing type* are provided *at no extra cost* for sealing the cylinder ports.

Additional advantages of these fittings are:

1. All circuit piping and fittings can be easily positioned.
2. Damage to equipment caused by high tightening torque is completely eliminated (especially on valves, pumps, etc.)
3. Sealing material is Teflon, which is compatible with all hydraulic fluids (J. I. C. Standard H6.2.1)

Specify Miller For Greater Reliability



Engineering Bulletins on Miller Air and Hydraulic Cylinders Available on Request

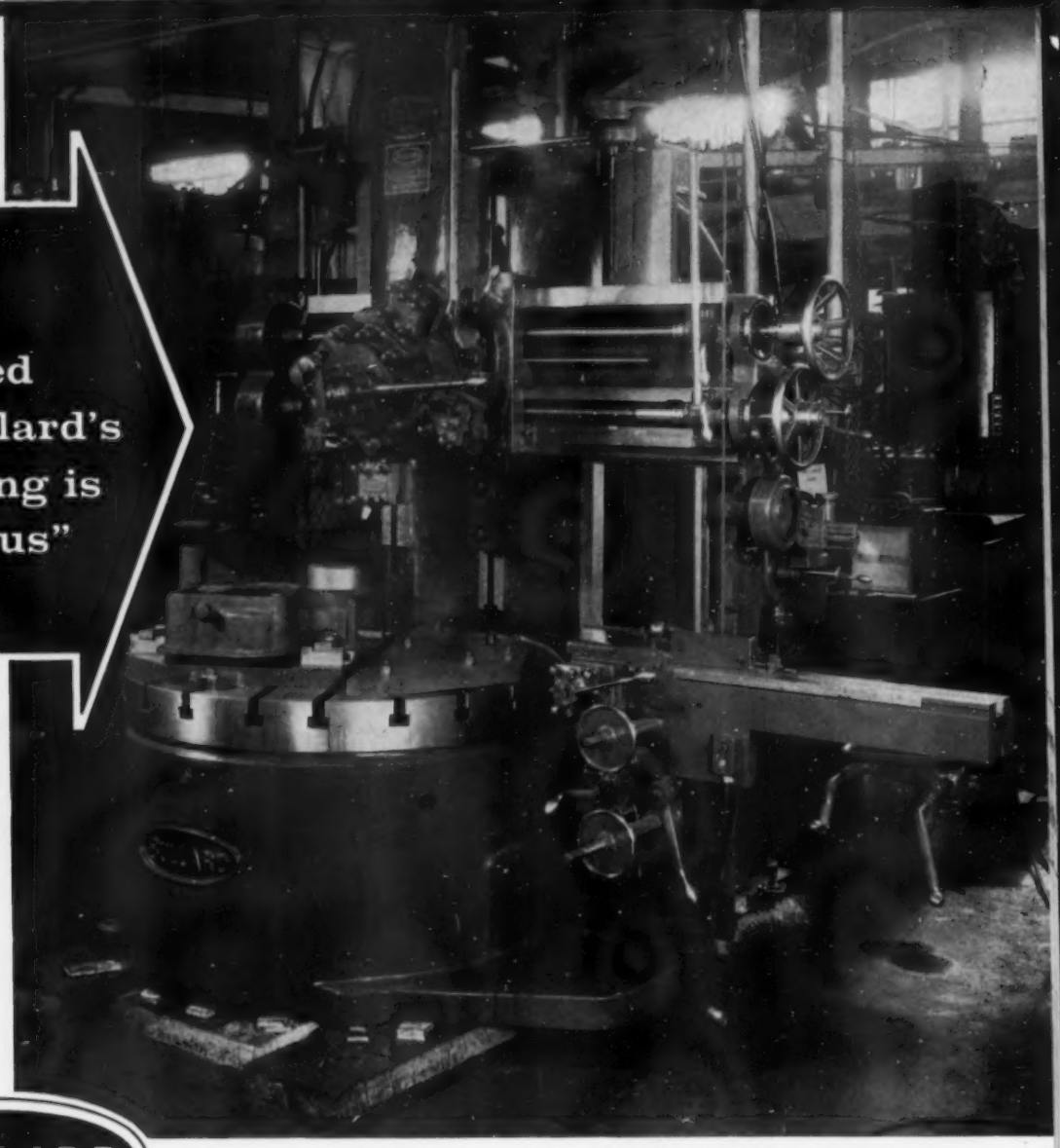
MILLER FLUID POWER

DIVISION OF FLICK-REEDY CORPORATION

2010 N. Hawthorne Ave., Melrose Park, Ill.

AIR AND HYDRAULIC CYLINDERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS • BOOSTERS

"We're convinced that Bullard's rebuilding is best for us"



BULLARD

54" Spiral Drive V.T.L. – similar to one rebuilt for Cann & Saul Steel Co.

About a year ago, the Cann & Saul Steel Company, Royersford, Pa., had The Bullard Company rebuild its 54" Spiral Drive V.T.L. Says Mr. Russell Freed, Vice President, "After Bullard disassembled the machine, I visited their plant to check on certain phases of the rebuilding and believe me when they say "Bullard rebuilds from the ground up" they mean exactly that — it was completely disassembled right down to the last bolt. We were so satisfied with their work on this machine that we since have had them rebuild our 42" Spiral Drive V.T.L. — in other words — one good job deserves another."

This same reliable rebuilding, guaranteed for one full year, both parts and labor, can be applied to your Bullard equipment. For information, just mail the coupon or write

THE BULLARD COMPANY
BRIDGEPORT 9, CONNECTICUT

THE BULLARD COMPANY 286 Canfield Avenue, Bridgeport 9, Conn.
Gentlemen: Please have your salesman call to discuss rebuilding our

_____

YOUR NAME _____ TITLE _____

COMPANY _____

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Now... DoALL
BLACK GRANITE SURFACE PLATES
are available in

• THREE ACCURACIES

Laboratory Grade (AA)	.000025"
Inspection Grade (A)	.000050"
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Available in the fine area accuracies shown above and to over-all accuracies from .000050" to .004". You can buy the exact grade needed, with or without ledges, to meet your requirements.

• MORE SIZES

Heavier demands and expanded production now enable DoALL to supply black granite plates in over 400 combinations of sizes, ledges and accuracies.

DoALL surface plates are made from the finest black granite available. Comparative tests rank it highest in compression strength, density and weight, and lowest in absorption and porosity. DoALL's black granite is extremely dense, rigid, fine-grained, and hard enough to be used for cutting and polishing ordinary granites.

Using the best of all granites, DoALL's master gage makers, metrologists and quality control engineers pool their know-how to manufacture the very finest surface plates. The result: a complete line of surface plates of guaranteed accuracy.

WRITE FOR NEW CATALOG

The sizes, designs and specifications of DoALL's complete line of black granite surface plates and accessories are shown in a new free catalog. Write for your copy today. Or call your local DoALL Sales-Service Store and ask for a DoALL Engineer to recommend the black granite products best suited to your production and inspection needs. His expert advice is free.

DoALL ECONOMY SPECIAL

DoALL Black Granite TOOLMAKERS' FLATS

Here is the handy, inexpensive yet accurate foundation to be used by your machinists, toolmakers, diemakers, assemblers and many others.

Size: 8" x 12" x 2"
Accuracy: .0002" over-all
Regularly a $22.00 value

ONLY $19.50

BG-3

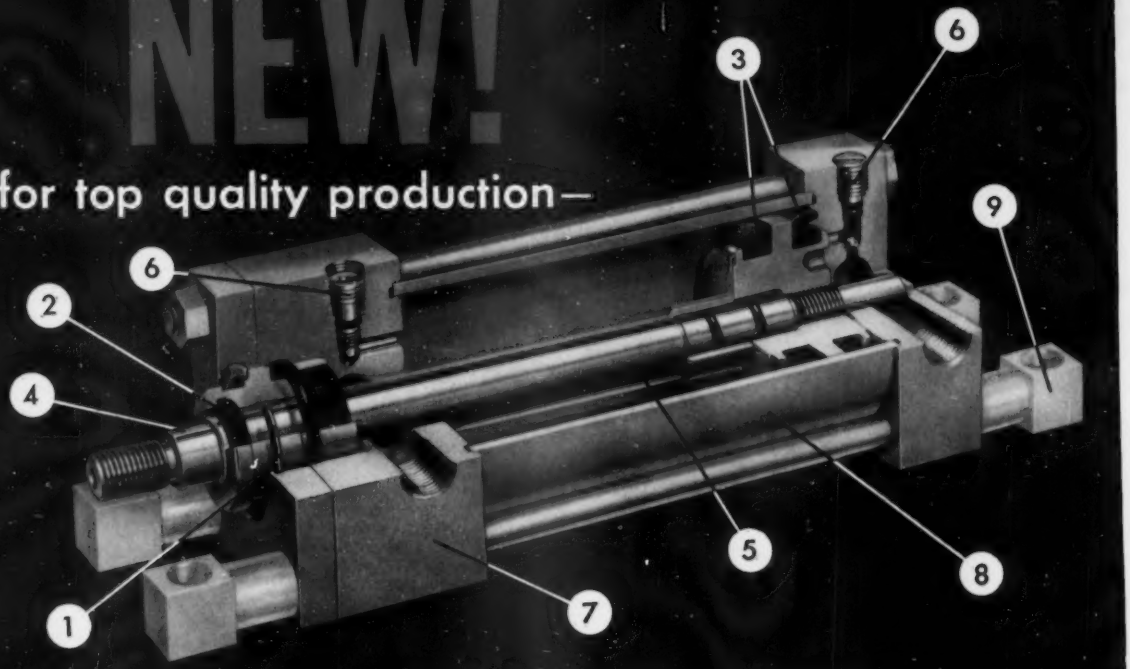
THIS IS A TYPICAL DoALL STORE

The DoALL Company, Des Plaines, Illinois

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-273

NEW!

for top quality production—



1. Bronze Bearing, with self-adjusting "U" Cup Piston Rod Seal for longer wear.
2. Rod Wiper protects Piston Rod Seal and keeps Cylinder clean.
3. "U" Cup Seals expand with pressure to provide positive seal with minimum friction.
4. Wrench Flats make for easy installation.
5. Ground, hard chrome-plated Piston Rods have minimum yield strength of 125,000 psi.
6. Self-locking cushion adjusting screw and ball check are below surface for protection . . . easily accessible.
7. For extra strength, Cylinder Ends and Mounting Plates are machined from bar stock and steel forgings.
8. Cylinder is precision-finished brass for extra heavy duty.
9. Variety of mountings can be interchanged—easily match any installation requirement.
10. Interchangeable with all JIC Cylinders.

SCHRADER SQUARE-END CYLINDERS

meet and exceed JIC specs . . . 250 psi air . . . 750 psi hydraulic!

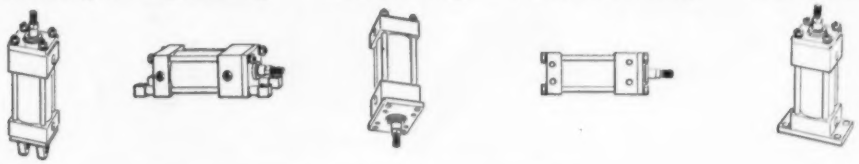
Here's compact, versatile straight-line power. Just look at the features!

Use Schrader's new square-end double-acting cylinders for holding, positioning, moving work—for push, pull or lifting—for automating manual operations. In five sizes up to 4-inch bore, and with five interchangeable mountings, these "square-ends" are economical and versatile. Bolt, leg, flush, side flush or base . . . each JIC Cylinder will mount all five ways. Suitable for air pressures to 250 psi, or hydraulically to 750 psi—available cushioned or non-cushioned.

You get safe, controlled, low-cost power with Schrader "square-ends"—another addition to the line of famous Schrader quality Air Control Products.

Complete stocks available locally—expert help to improve your air control hookups. Write for your complete specifications and data on these new "square-ends."

Bolt Mounting **Leg Mounting** **Flush Mounting** **Side-Flush Mounting** **Base Mounting**



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a division of SCOVILL

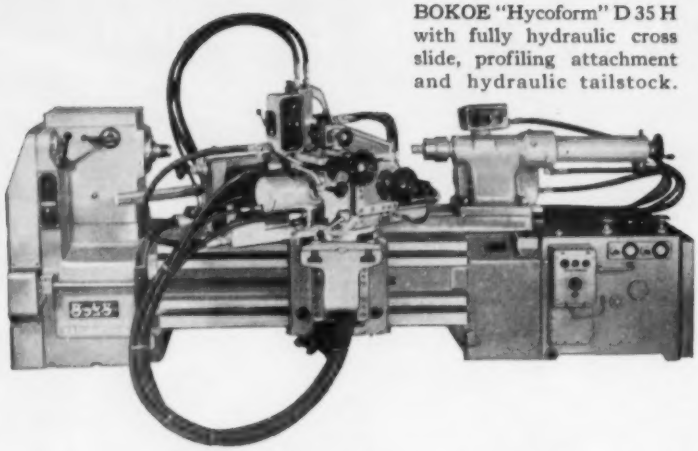
A. SCHRADER'S SON
Division of Scovill Manufacturing Co.
462 Vanderbilt Avenue, Brooklyn 38, N. Y.

QUALITY AIR CONTROL PRODUCTS

You can Adapt BOKOE
Flow Forming & Spinning Lathes To Your Exact Production Needs

From simple spinning lathes to fully hydraulic "Hycoform" machines with built-in copying attachment and automatic cycle control.

BOKOE adaptability can save you money—and simplify your spinning or flow forming production problems. BOKOE's "building block" design lets you choose a machine suited exactly to your production requirements. You don't have to "get by" with sub-capacity machines, or over-invest in more machine than you need. And you can extend the production performance of your BOKOE machine whenever necessary.



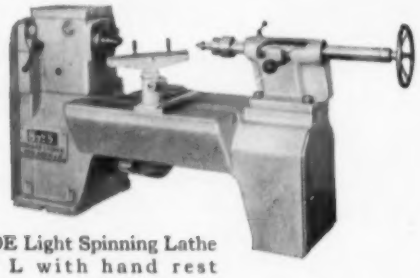
BOKOE "Hycoform" D 35 H with fully hydraulic cross slide, profiling attachment and hydraulic tailstock.

From basic design with hand rest and mechanical tailstock, BOKOE machines can be extended to include:

- Mechanical, hydro-mechanical or fully hydraulic cross-slide
- Front only or combined front & rear cross-slides
- Mechanical or fully hydraulic tailstock
- Built-in, hydraulic copying attachment
- Automatic cycle control

There's a BOKOE machine for every type of spinning and flow forming operation—for light and heavy work on ferrous and non-ferrous materials—for cylindrical and conical shapes and nose cones used in aircraft and missile applications.

- Flow forming of Aluminum up to ⅝" thickness
- Flow forming of soft steel up to ¼" thickness
- Swing up to 86" maximum
- Longitudinal slide movement of 40"



BOKOE Light Spinning Lathe D 35 L with hand rest and mechanical tailstock.

FACTORY DEMONSTRATIONS

New York: April 27-29
Cleveland: May 6-8
Chicago: May 14-16
Los Angeles: May 27-29

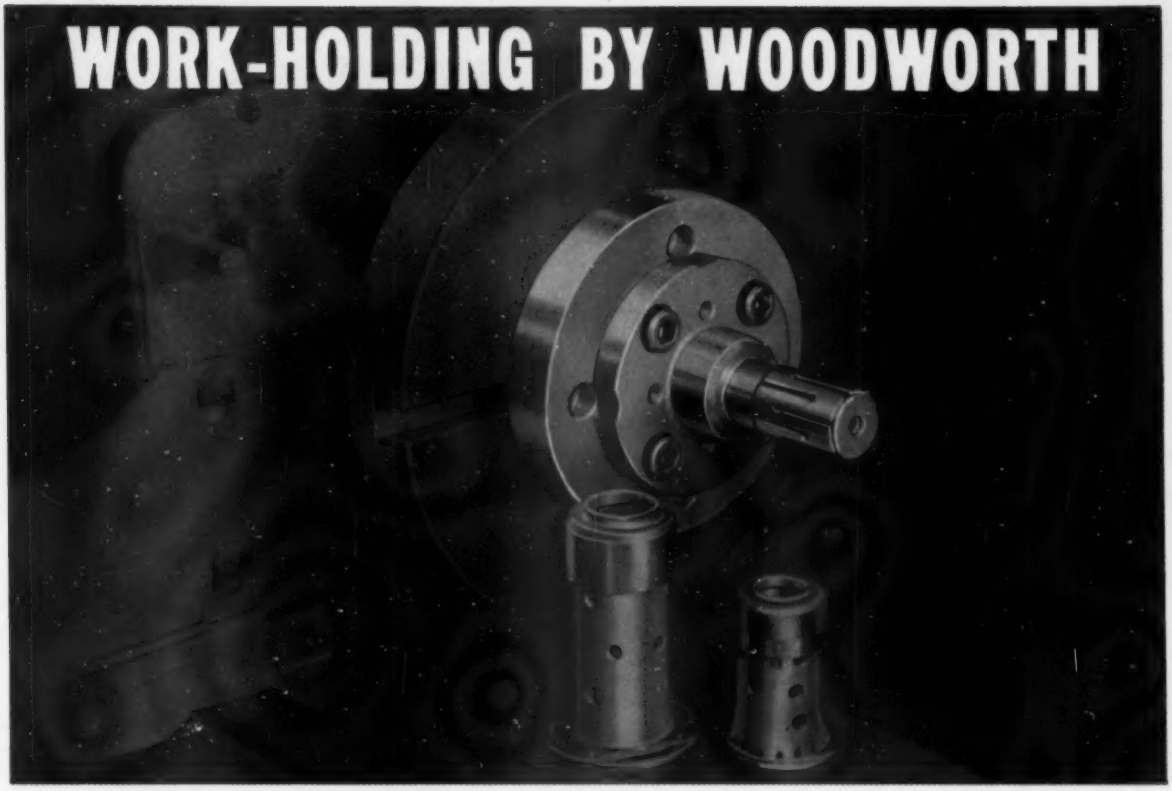
Write For Information

COSA — *nationwide sales and service of precision machine tools—from bench lathes to boring mills.*

COSA CORPORATION, 405 LEXINGTON AVENUE, NEW YORK 17, N.Y.

In Canada contact COSA CORPORATION, LTD., 1160 Lakeshore Road, Long Branch, Toronto 14, Ontario

WORK-HOLDING BY WOODWORTH



WOODWORTH ARBOR ASSURES POSITIVE DRIVE IN CRITICAL AIRESEARCH OPERATION

TOM M. LAWTHERS

- **TOM M. LAWTHERS**, General Supervisor of Production Engineering, AiResearch Manufacturing Division, The Garrett Corporation in Los Angeles, explained his tooling problem this way: *"In producing the air turbine bearing carrier for aircraft refrigeration packages, it was necessary to produce a unit with a precision shaft carrying components which rotate at very high speeds. The I.D. and O.D. are held within .0002 and normalities within .0005 on all ground diameters. Without the Woodworth Drawbar Operated Arbor it would be extremely difficult. It is absolutely necessary to have holding equipment which permits a positive drive. Selective fit arbors, or tapered arbors simply wouldn't do the job like the Woodworth Drawbar Operated Arbor."*

- The two air turbine bearing carriers, pictured above in the foreground of a Cincinnati Universal Grinder, seem small and sturdy in appearance, but actually are extremely delicate. These critical parts have precision shafts carrying rotating components as high as 75,000 r.p.m. The problem confronting AiResearch Engineers was how to avoid using a selective fit arbor, with centers on each end, since using a tapered arbor was impossible due to a shoulder-type shaft hole in the bearing carrier. The answer was Woodworth's Drawbar Operated Arbor, selected as the only equipment capable of giving positive drive and having the necessary elements to assure accuracy and stability.

WRITE FOR ARBOR CATALOG 3-58

When You Buy, Specify

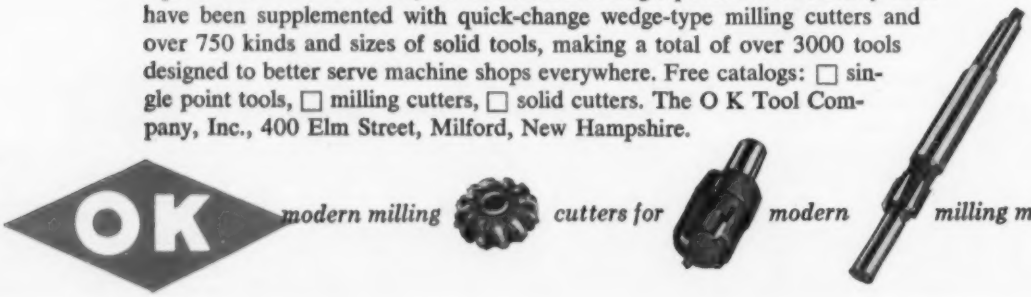
ACCURACY YOU CAN TRUST

WOODWORTH

1300 EAST NINE MILE ROAD · DETROIT 20, MICHIGAN

styles and sizes for every milling operation . . .

Today O K Tool offers one of the most comprehensive lines of milling cutters in the industry. It consists of many "firsts": the first single-point tools with interchangeable tool bits for lathe, planer, shaper and boring mill jobs; the first milling cutters with tapered and serrated blades; the first shankless single-point tools. Recently these have been supplemented with quick-change wedge-type milling cutters and over 750 kinds and sizes of solid tools, making a total of over 3000 tools designed to better serve machine shops everywhere. Free catalogs: ☐ single point tools, ☐ milling cutters, ☐ solid cutters. The O K Tool Company, Inc., 400 Elm Street, Milford, New Hampshire.



EDLUND

The Greatest Advance in Drilling and Tapping Machine in the Past 25 Years

PRODUCTION INCREASED
QUALITY IMPROVED
COSTS REDUCED

ARO EQUIPMENT CORPORATION

Bryan, Ohio Plant

Production line of EDLUND Model 2F Infinitely Variable Speed Drilling and Tapping machines turns out drilled and tapped parts faster, with better quality and at lower cost.

These powerful EDLUND machines give constant service with minimum downtime and feature flexibility to handle a wide variety of drilling, reaming, chamfering, counterboring, and tapping operations.

There is an **EDLUND** for your drilling and tapping jobs:

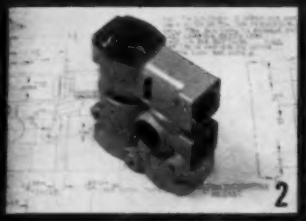
Model 1F
⅜" Capacity
Spindle speeds to 10,000 rpm.
Bulletin 160

Model 2F
1¼" Capacity
Spindle speeds to 3600 rpm.
Bulletin 140R

Model 4F
1¾" Capacity
Spindle speeds to 2200 rpm.
Bulletin 170R

Model 2G Gun Drilling
⅝" Capacity
Spindle speeds to 8000 rpm.
Bulletin 2G

1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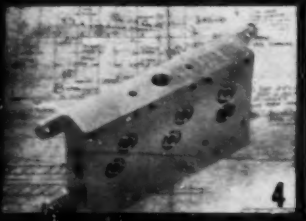
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Some of the many precision parts drilled and tapped with EDLUND Model 2F machines at Aro Equipment Corporation:

1. AIR TOOL HOUSING—8 drilling operations, 2 tapped holes #32 7/16".
2. AUTO VALVE BODY—15 holes, 10-32, Class 3 threads.
3. BRASS PUMP BLOCK—30 drilling, reaming and tapping operations.
4. VALVE BODY—16 spindle operation, ⅛"-⅜" holes, and 12 counterbores.

SPECIAL MACHINES • EDLUND'S years of experience at your request to design special application machines.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-279

Write for FREE Descriptive Bulletins

EDLUND REPRESENTATIVES IN MAJOR CITIES

EDLUND

MACHINERY COMPANY

Cortland, New York

Division of Harsco Corporation

Top Tooling is a 3-way responsibility of a 3-Man Team: (1) Your Tool Engineer—who knows your customer's requirements and the job schedule. (2) Your machine operator—who knows the ability and limitations of the machine, and (3) Your Kennametal Carbide Engineer—who knows which carbides to use and how to apply them.

It takes this 3-Man Team to modernize TOOLING for PROFITS

Leading tool engineers agree that the metalworking industry has been losing thousands of dollars annually through improper tools and techniques. But today's business climate dictates a good hard look at loose production practices . . . large tool inventories, costly regrinding, less-than-possible output! It's time to TOP TOOL, which means to get the *right tool* on every job—on *every machine* in your line.

Here's how your KENNAMETAL* CARBIDE ENGINEER can help you Tool for Profits:

1 With Kennametal tooling service

Helping you choose and apply the tools that will machine every job at a profit is the Number 1 assignment of your Kennametal Carbide Engineer. Your knowledge of the shop and job requirements, plus his thorough knowledge of Kennametal Tooling, give you the Top Tooling for increased profits.

2 With the right grade for every job

Once a study has determined the best tooling for your operations, the comprehensive Kennametal line provides a performance-proved grade to meet the specific needs of every job.

General purpose needs can be satisfied from Kennametal Group I grades which were recently expanded by the addition of grades K4H and K2S.

By moving these grades, previously classed as "premium," into the General Purpose Group, Kennametal now provides a total of seven economy-priced grades suitable for a broad range of jobs —and has opened the door to further savings by reducing inventory requirements.

For the ultimate in performance on specific jobs, Group II provides a grade selection tailored for today's high alloy materials, closer tolerances, higher cutting speeds, and specialized operations.

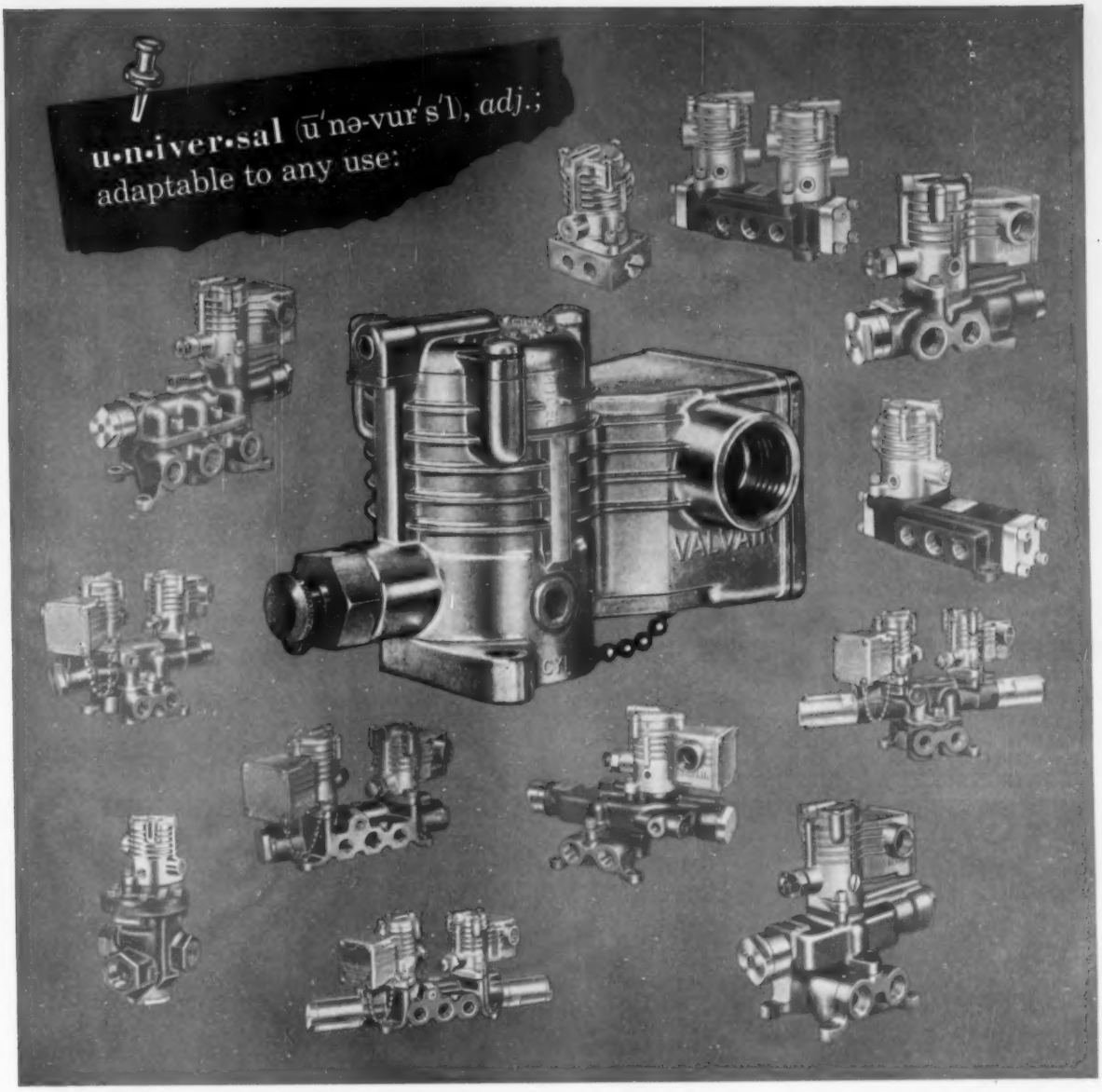
3 With the right tool for every operation

Kennametal offers you the world's most complete line of brazed and clamped-insert type tools . . . spearheaded by the Kendex* (patented) line with more than 50 standardized styles plus many adaptations for special needs.

Let your Kennametal Carbide Engineer work with you to get the best tooling on your machines to squeeze more profit from every job today . . . and help you get set for stiffer competition tomorrow. Call him now, or write KENNAMETAL INC., *Latrobe, Pennsylvania.* 8764

*Trademark.

INDUSTRY AND KENNAMETAL ...Partners in Progress



VALVAIR'S one universal pilot operates any SPEED KING® valve!

Valvair's one *universal* pilot—completely interchangeable on all Speed King valves—has only two moving parts. It's built to handle your toughest jobs.

Why complicate production, maintenance and parts inventory on the machines you build or operate, by using control valves that require an assortment of pilots?

For peak performance . . . unmatched reliability . . . minimum parts inventory . . . specify Valvair Speed Kings, the valves with *universal* pilots!

8002

For more information, write for Bulletin D-58. Address Dept. TE-459, Valvair Corporation, 454 Morgan Ave., Akron 11, Ohio.

Representatives in principal cities.

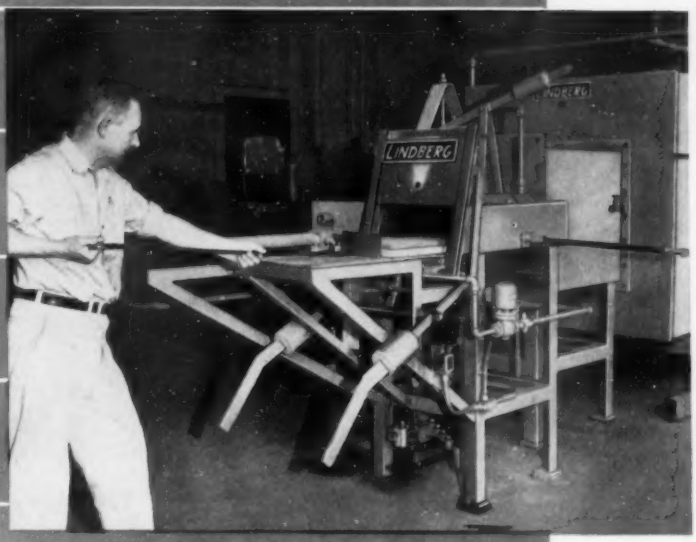
Valvair AKRON 11, OHIO

A DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

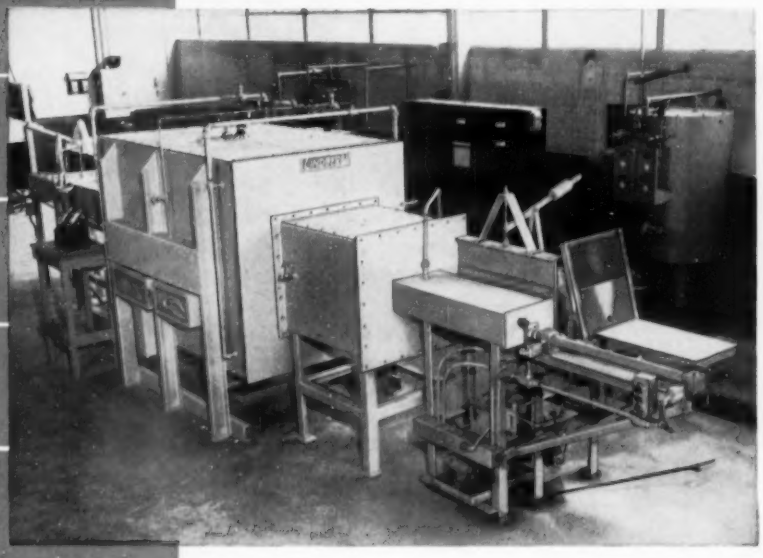
Other INDUSTRIAL DIVISIONS of IBEC: The Sinclair-Collins Valve Co. The Bellows Co., Akron, Ohio • V. D. Anderson Co., Cleveland, Ohio

If your production needs call for Sintering call on Lindberg for just the right Furnace

As it does in all types of industrial heating equipment; Lindberg provides a complete line of sintering and brazing furnaces. Here is one of our latest:



A new Lindberg development, this Molybdenum Element Atmosphere Pusher Furnace is designed with high temperature refractories suitable for low dew point without need for a muffle. It is now being used for sintering stainless steel compacts in hydrogen or dissociated ammonia. Ammonia dissociator and control panels are shown at the right of the furnace below. In this installation hydrogen supply cylinders are located outside the building. Furnace provides side loading and discharge ports with purging chambers. Work trays, ceramic slabs or molybdenum boats, move through the furnace by hydraulic pusher. If you have a sintering or brazing problem why not talk it over with Lindberg. Just get in touch with your nearest Lindberg Field Representative or write us direct. Lindberg Engineering Company, 2447 West Hubbard Street, Chicago 12, Illinois.

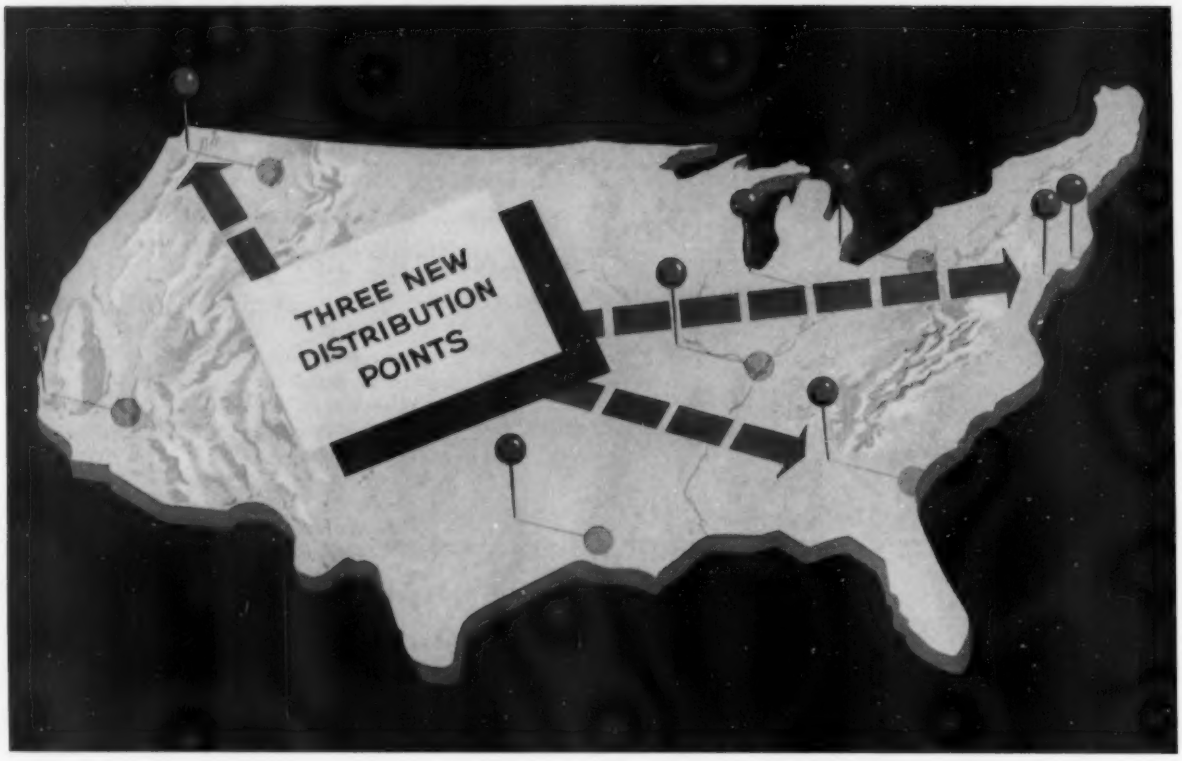


Type MOP-12307-A88C Molybdenum Element Atmosphere Pusher Furnace. Maximum Temperature 3000° F. 60 KW input. 12" wide, 30" long, 7" high. 60" cooling chamber, 36" long preheat chamber.

LOOK UP LINDBERG, BOOTH 2, AT METAL POWDER SHOW IN PHILADELPHIA

LINDBERG heat for industry

DOW | MAGNESIUM



DOW ADDS NEW SUPPLIERS

speeds service on magnesium tooling plate

E. F. BAILEY COMPANY
1000 Fourth Avenue So., Seattle 4, Washington, MAin 4-5715

CLENDENIN BROS., INC.
4309 Erdman Avenue, Baltimore, Maryland, EAstern 7-4500

HUBBELL METALS INC.
356 Sessions Street, Marietta, Georgia, 7-3718

To meet the growing demands of industry for magnesium tooling plate, Dow has expanded its distribution network. Three new suppliers will help to speed delivery and make it more convenient to buy magnesium tooling plate and square tubing.

Lightweight, low-cost, easy-to-handle magnesium tooling plate cuts machining time, welds easily. Close flatness tolerances and high dimensional stability make surface machining unnecessary for most tooling uses.

Consider magnesium for your tooling needs. Contact the Dow magnesium supplier near you, or write THE DOW CHEMICAL COMPANY, Midland, Michigan, Dept. 1335FJ4.

MAGNESIUM TOOLING PLATE IS ALSO AVAILABLE FROM STOCK AT:

COPPER AND BRASS SALES, CLEVELAND, OHIO

COPPER AND BRASS SALES, DETROIT, MICHIGAN

FULLERTON STEEL AND WIRE CO., CHICAGO, ILLINOIS

HUBBELL METALS INC., KANSAS CITY, MISSOURI

HUBBELL METALS INC., ST. LOUIS, MISSOURI

A. R. PURDY., INC., LYNDHURST, NEW JERSEY

RELIANCE MAGNESIUM CO., LOS ANGELES, CALIFORNIA

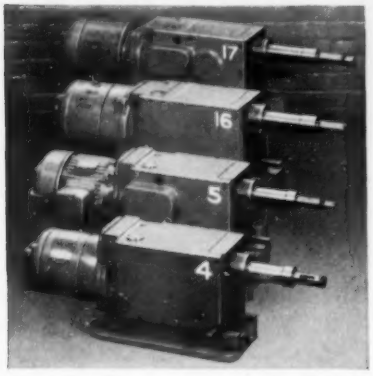
JOSEPH T. RYERSON & SON, INC., DALLAS, TEXAS

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

New Automatic Units with Cam Feeds and Long Strokes

Four new Kingsbury automatic self-contained units combine all these features for better production drilling and tapping —

- Strokes of 4 or 5 inches
- Cam feeds for accurate repetition of the work cycle every time
- Positive drive with friction safety clutch
- Continuous flow of oil from a rotary pump
- Interchangeable air or electric controls
- Mounting in almost any position
- May be converted for either drilling or tapping operations



Quills are fully extended to show available strokes —
4 inches on models 4 and 5,
5 inches on models 16 and 17.

Fully Tested and Guaranteed

These new developments result from 35 years of experience in building automatic drilling and tapping units. They stand up well under rugged production demands. Work cycles are always the same for uniform product. Operation is reliable. Here at Kingsbury our shop men praise them, and that is rather an acid test.

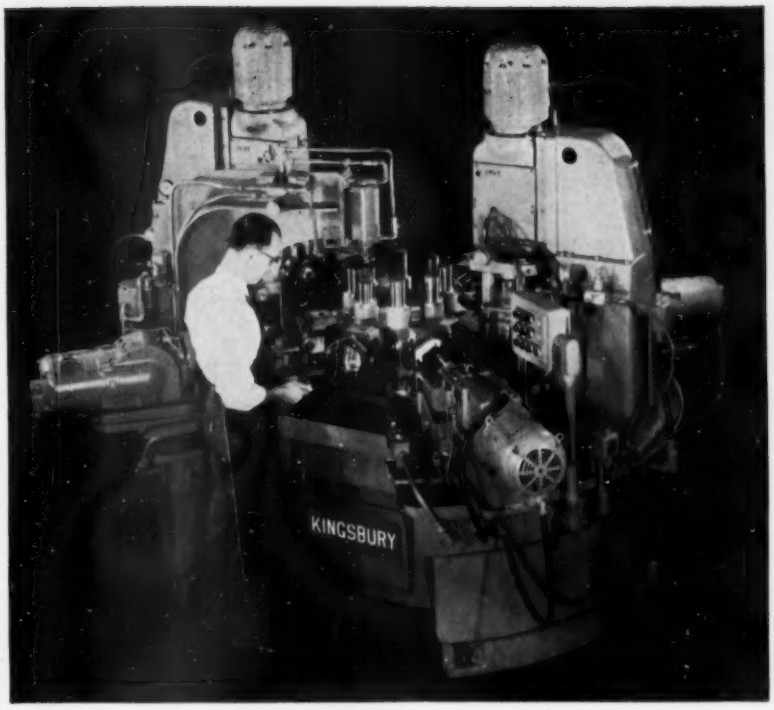
Horsepower and Spindle Speeds

MODEL	HP	SPINDLE RPM
4 driller	½	750 — 4100
	1	1500 — 8200
5 tapper	¾	465 — 1415
16 driller	1½	596 — 3500
17 tapper	1	368 — 2160

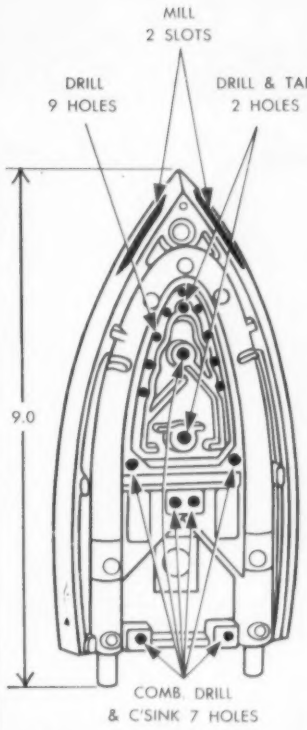
Capacities

MODEL	CAST IRON	FORGED STEEL
4 driller	⅜	5/16
5 tapper	⅜-16	5/16-18
16 driller	¾	½
17 tapper	⅝-11	½-20

Kingsbury Machine Tool Corp., Keene, N. H.



22-spindle Kingsbury mills 2 slots, drills 18 holes, taps



DIE CAST ALUMINUM FLAT IRON SOLE PLATE

Five horizontal and two vertical units operate 22 tools. The vertical units mill the slots with six-inch cutters. Each cutter rotates so the thrust is down. The slots, incidentally, make it easier to iron around buttons.

Four horizontal units drill 11 holes and combination drill and countersink 7 holes. Bushings guide these tools. The last unit taps two of the holes.

A 30-inch index table holds eight work fixtures. Each has power clamping and automatic unclamping through use of an air cylinder. The point of the work is up, and clamping is outward against a fixed front plate. Gross production is 520 parts per hour.

Production men praise our machines. "Can't remember when we had trouble with them."

"Our Kingsburys do a nice job for us."

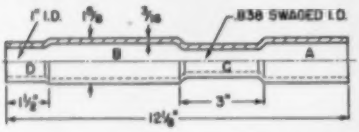
"Hardly ever get a bad part."

We think we earn those compliments. Forty years behind us and we still work hard on every machine we build. Good basic design, rugged construction, test runs before shipment — all that sort of thing really pays off.

For high production at low unit cost, ask to have a representative call and talk over your jobs. Let him get you a specific proposal. If we say we can do it, we can do it. **Kingsbury Machine Tool Corp., Keene, N. H.**

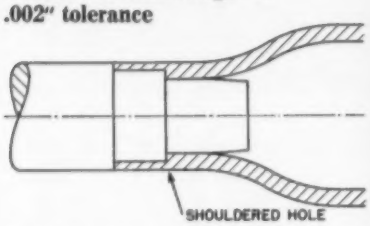
KINGSBURY MULTI-UNIT AUTOMATICS

Swaging lowers costs



To bore and recess cavities A and B to provide tool runout for broaches or taps is a costly operation. It is simply and quickly done on a Torrington Electro-Hydraulic Die Closing Rotary Swager. Section C is closed in by the wedge-operated die using a mandrel to hold ID tolerances. Rate: 240 per hour. Section D is swaged by conventional operation of the machine at 350 per hour. Swaging over a mandrel often eliminates further drilling or reaming operations.

Shouldered hole swaged to .002" tolerance



Copper or aluminum accumulator tubes often require a shouldered hole of two diameters to provide for assembly of a connecting tube. Both diameters can be held to .002" by swaging over a shouldered mandrel. Swaging eliminates a drilling operation and produces a smoother and more accurate hole. Production rate on 1" tubes with 20° inc. angle is as high as 240 per hour.

Swaging forms long threads

Rotary swaging can conveniently thread long lengths. For example, the Model 211 Torrington Swager, running at 570 rpm on 32 pitch thread would turn out about 18 inches per minute with no chips. Swaging produces Class 2 threads, with one thread every spindle revolution.

Can ALL these parts be swaged?

YES—versatile swaging is faster and more economical!

These and many other operations can be done faster, more economically on a Torrington Rotary Swaging Machine—pointing, tapering, reducing, sizing, forming inside contours. Because swaging moves metal, many parts can be swaged in less time, using less materials without turning a chip. Applications of swaging are being extended daily by Torrington to answer production problems—saving money, improving tolerances and finish. Your Torrington engineer can show you new ways to swage many parts you are now machining. Make a note today to call him. The Torrington Company, Swaging Machine Division, North Street, Torrington, Conn.

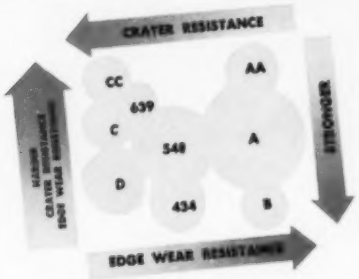
TORRINGTON ROTARY SWAGING

New! ADAMAS Grade Selection Chart

YOUR GUIDE TO PROPER GRADE SELECTION

MATERIALS

Cast Iron, Copper, Aluminum, Brass, Bronze, Magnesium, Molybdenum, Rubber, Fibre, Masonite, Wood, Plastics, Zinc Alloys, Titanium and Titanium Alloys, Nimonic A, Ni Hard, light cuts on 300 stainless steels. Any material where feed of less than .005 is being used.	SAE 1000, 2000, and 8600 Series.	SAE 3000, 4000 Series SAE 52100, Nitralloy, Monel, Inconel. Heavy cuts on Series 300 Stainless Steels. Series 400 Stainless Steels.
ADAMAS GRADE B, A, AA	**ADAMAS GRADE D, C, CC**	**ADAMAS GRADE 434, 548, 639*** * Grade 639 stocked only in throwaways.
ALSO USED TO MACHINE ANY MATERIAL WHEN EDGE WEAR IS THE PRIMARY PROBLEM.	**ALSO USED TO MACHINE ANY MATERIAL WHEN CRATERING IS THE PRIMARY PROBLEM.**	**ALSO USED TO MACHINE ANY MATERIAL WHEN BOTH EDGE WEAR & CRATERING ARE PROBLEMS.**



EXAMPLES

WHEN MACHINING A MATERIAL WITH GRADE A . . .
- If excessive edge wear occurs change to Grade AA.
- If chipping occurs change to Grade B.
- If cratering is excessive change to a steel cutting grade (probably Grade C).
- If both excessive edge wear and cratering occur switch to Grade 548.

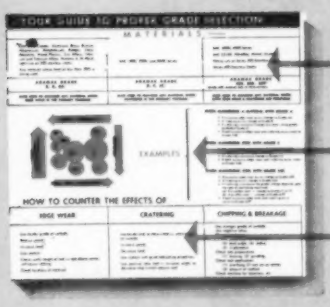
WHEN MACHINING STEEL WITH GRADE C . . .
- If excessive edge wear occurs change to Grade CC.
- If chipping occurs change to Grade D.
- If cratering is excessive change to Grade CC.
- If both excessive edge wear and cratering occur switch to Grade 548.

WHEN MACHINING STEEL WITH GRADE 548 . . .
- If excessive edge wear occurs change to Grade 639.
- If chipping occurs change to Grade 434.
- If cratering is excessive the grade change depends upon the type of steel being machined.
  (a) If a carbon steel — change to Grades C or CC.
  (b) If an alloy steel — change to Grade 639.
- If both excessive edge wear and cratering occur switch to Grade 639.

HOW TO COUNTER THE EFFECTS OF . . .

EDGE WEAR	CRATERING	CHIPPING & BREAKAGE
Use harder grade of carbide. Reduce speed. Increase feed. Use coolant. Check center height of tool — tool above center will cause rubbing. Check hardness of material.	Use harder and/or more crater resistant grade of carbide. Increase speed. Decrease feed. Use coolant with good lubricating properties. Use positive rake tool — increase angle to decrease chip friction against tool.	Use stronger grade of carbide. Use negative rakes. Check tool design: (1) shank size (2) tip size (3) lead angle (4) radius (5) chipbreaker Check tool preparation: (1) brazing (2) grinding Check tool application: (1) overhang (2) tool not on center (3) amount of coolant Check machine for looseness, etc.

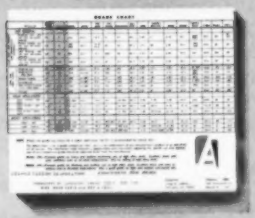
Designed to give you a practical guide to carbide grade selection and application.



Shows what grades to use on a wide range of materials . . . stainless steels, titanium, etc.

Quick reading diagram for fast grade reference.

Valuable application data on how to counter the effects of Edge Wear, Cratering, Chipping and Breakage.



Reverse side carries complete and up-to-date Carbide industry grade chart (Industry designations C-1 thru C-14).

Ideal for shop posting or desk use . . . size 8" x 10", printed on heavy soil-resistant, high gloss stock.

Send for your Free copy of this chart today.

ADAMAS

CARBIDE CORPORATION
KENILWORTH, NEW JERSEY

Producers of Tungsten Carbide Tools, Tool Tips, Dies, Wear Parts and Dex-A-Tool

CUT OUT AND MAIL

ADAMAS CARBIDE CORPORATION
DEPT. 281 KENILWORTH, NEW JERSEY

Please send me a copy of the new Adamas chart titled *"Your Guide To Proper Grade Selection"*.

NAME _____ TITLE _____

COMPANY _____

STREET _____

CITY _____ STATE _____

If you're "planning for profit"

Illustrated here is a Gorton Mastermil with O-16A Super-Speed Spindle Head and Ram Assembly with G. E. Mark II Numerical Control System

GORTON NUMERICAL CONTROL

is field tested and proved in use

This is how Gorton Numerical Control saves you money on short runs:

- — eliminates elaborate and costly tools, dies, jigs and fixtures
- — wastes no time because operator does not "pace" the work
- — makes no mistakes because operator skill not required
- — extreme, repetitive accuracy is easy and automatic
- — change overs in set-ups can be made quickly
- — signals operator when tool changes are needed
- — guides cutter in close quarters without damage to work or cutter
- — making punched tape is simple typewriter operation

Punched tape . . . or magnetic tape control . . . is available to you on SIX standard Gorton machines and also on Gorton custom-designed machines. You'll be agreeably surprised when you learn the low cost of Gorton Numerical Control and how much more it gives you for your money. For full information write

Saves You Money on —

- face milling
- side milling
- end milling
- straight line cavity milling
- slotting
- drilling
- reaming and boring

Your letterhead inquiry will receive prompt attention.

GORTON

SINCE 1893

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2604 Racine Street • Racine, Wisconsin

Tracer-Controlled Pantographs, Duplicators — standard and special . . . Horizontal and Vertical Mills, Swiss-Type Screw Machines, Tool Grinders, Small Tools and Accessories.

Index of Advertisers

April 1959

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LOOKING AHEAD

By T. W. Black
Senior Associate Editor

Looking way, way ahead, William F. Hufstader, GM vice president, predicts a population increase of some 64 million Americans by 1975. This is equivalent to a market represented by the populations of France, the Netherlands, Norway and Sweden. The gross national product is estimated to reach $835 billion in the same period and average individual incomes will increase by $700 after taxes. Some companies are planning long-range expansion programs now to fill the needs of this expanding market.

Lower foreign wage rates are frequently mentioned as a factor making it impossible for American manufacturers to compete in the world market. A prominent business executive, recently returned from Europe and Japan, points out that wage rates, in themselves, don't mean much. The real measure of competitive ability is productivity per labor dollar. Since American workers are much more productive than their foreign counterparts, it follows that manufacturing costs here and abroad are closer than most people think. The executive states that American industry can produce almost any product at about the same cost as Japanese industry because of high American productivity per worker hour.

Another factor leading to high productivity is, of course, the use of modern machine tools. It has been estimated that the majority of machine tools in this country are technologically obsolete; that is, replacement with more modern tools could boost productivity three or four times.

Cost of modernization is not as high as most engineers think. In this issue of THE TOOL ENGINEER (page 92) Carl M. Beach of The Heald Machine Co. points out that the actual cost of buying a $12,000 machine tool is about 29 cents per working hour. This machine will probably be many times more productive than the machine it replaces. Often the maintenance cost on an older machine exceeds 29 cents per hour.

A spectacular advance in cutting tool materials has been announced by the Ford Motor Company Scientific Laboratory. The new material is a titanium carbide, containing about 80 percent titanium, 10 percent nickel and 10 percent molybdenum.

In extensive production tests in the Rouge plant, the new material demonstrated up to seven times longer life than the tungsten carbides previously used for cutting steel.

Ford has produced tools for its own use, but does not plan to go into the tool business. The material will probably be produced by several companies, operating under a licensing arrangement.

NUMERI-TROL

59-3

COMPUTER INPUT TAPE USED IN PREPARATION OF MACHINE CONTROL TAPE

TAPE CONTROLLED PRECISION PROFILING MACHINES BY EX-CELL-O

FIRST to provide 360° work rotation for 3-dimensional machining of complex parts

FIRST to combine grinding, dressing and dressing compensation with milling

Numeri-Trol puts a new dimension into machining. Lead time goes down, tooling costs and machining time are cut in production of prototypes and complicated precision parts. Lateral movement of the work head and transverse travel of the cross slide combine with rotary work feed to permit milling and finish grinding impossible or uneconomical by ordinary standards. Wheel dressing and dressing compensation are fully tape-controlled. Numeri-Trol machining includes rotary and longitudinal milling with automatic work feed and 360° indexing.

Have a part that is costing too much to make? Find out how Numeri-Trol can produce it—economically! See your Ex-Cell-O Representative or write direct.

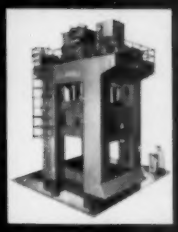
XLO EX-CELL-O FOR PRECISION

EX-CELL-O CORPORATION Machinery Division
DETROIT 32, MICHIGAN

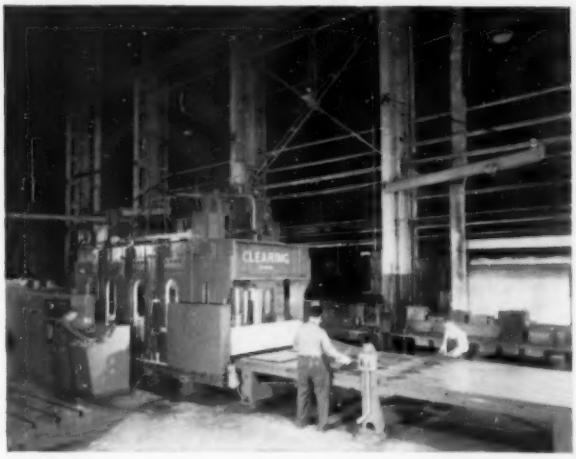
EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • THREAD AND GROOVE GAGES • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

When it comes to Hydraulic Presses...

large or small

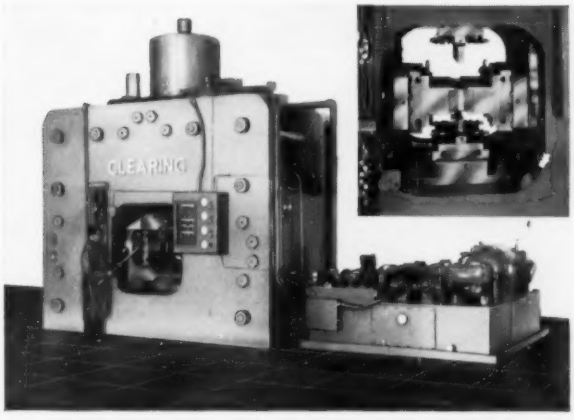


FOR ANY TYPE OF APPLICATION such as these metalworking drawing presses



WITH SPECIAL FEEDING EQUIPMENT as shown on this metal bonding machine

WITH ANY TYPE OF CONTROLS as seen on this rubber pad forming press



AND COMPLETE WITH THE TOOLING YOU NEED FOR THE JOB as we designed and built for this briquetting press

YOU GET THE MOST PRODUCTIVE EQUIPMENT AT CLEARING

There are no limitations on the type and size of hydraulic press equipment Clearing can design and build for you. No limitations either on the creative engineering you'll find at Clearing. Working with "new" metals—titanium, tantalum, columbium, uranium, zirconium?

Clearing will have a more productive answer for you. Investigating new processes and production techniques? Call on Clearing. You'll find a forward looking team of engineers that can work with you to solve your manufacturing problems effectively and economically.

Clearing, division of U. S. Industries, Inc. also manufactures power presses of all types, dies and special tooling, and special equipment for the aircraft and missiles industry.

USI

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